Contextualising Media Architecture

Design Approaches to Support Social and Architectural Relevance

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Abstract

Media architecture aims to alter our experience of public space through the use of digital media integrated within the built environment. While most current manifestations serve general commercial, artistic or entertaining purposes, we believe media architecture has the potential to become more socially and architecturally relevant. However, little is known on how media architecture becomes more contextually integrated, from a socio-demographic, technical and architectural perspective. In this dissertation, we describe the design and evaluation of four in-the-wild case studies that each address particular contextual challenges of media architecture. All studies utilise a design-oriented research methodology that combines architectural and participatory methods with those from human-computer interaction.

- In *OpenWindow*, we handed over the control of public displays to households. We were able to demonstrate how such open public displays positively influence social cohesion.

- In *StreetTalk*, we evaluated how participatory design is able to broaden the design space of sociable media architecture, and how user-generated content is characterised by particular local relevance.

- In *Encounters*, we analysed the contextual, spatial and social factors that influence engagement in public interactive systems.

- In *Stories of Exile*, we evaluated how participatory media architecture serves as an interface between local community members and refugees.

Our case studies demonstrate how media architecture becomes a sociable tool that is relevant in its context, by: 1) enabling multiple stakeholders to collaborate in the design; 2) communicating information that is grounded in the local identity; 3) incorporating design characteristics to promote engagement; and 4) optimising the integration within the surrounding architectural context.

Samenvatting

Media architectuur is een nieuw architecturaal communicatiemiddel in de publieke ruimte, waarbij gebruik gemaakt wordt van digitale media om visuele boodschappen te communiceren. Ondanks de impact van media architectuur op de beleving van onze publieke ruimte, is media architectuur vaak context-agnostisch door onvoldoende rekening te houden met het omliggend sociaal en architecturaal weefsel. Deze thesis bespreekt vier studies die de contextuele integratie van media architectuur blootleggen, vanuit een socio-demografisch, technisch en architecturaal perspectief. Elke studie hanteert een ontwerpgerichte onderzoeksmethodologie, waarbij architecturale en participatieve onderzoeksmethoden gecombineerd worden met methoden uit het domein van de mens-machine interactie.

- In *OpenWindow* beheerden gezinnen een eigen publiek scherm. We toonden aan hoe dergelijke schermen sociale cohesie positief beïnvloedden.

- In *StreetTalk* werd het effect van participatief ontworpen media architectuur geëvalueerd. We toonden aan hoe gebruikersgegenereerde boodschappen lokaal relevant zijn.

- In *Encounters* werden de contextuele, ruimtelijke en sociale factoren van engagement met publieke interactieve installaties geanalyseerd.

- In *Stories of Exile* werd geëvalueerd hoe diverse contextuele aspecten het effect van media architectuur beïnvloeden.

Onze studies tonen aan hoe media architectuur een contextueel relevant middel wordt om sociale interactie aan te moedigen, door 1) diverse belanghebbenden te laten samenwerken tijdens de ontwerpfase; 2) informatie te communiceren die de lokale identiteit reflecteert; 3) ontwerpkarakteristieken te integreren die engagement aanmoedigen; en 4) de integratie in de architecturale context te optimaliseren.

Acknowledgements

My work was born and nurtured in an academic community of architects, designers and social scientists. I feel honoured for having been able to collaborate with members of this community, and would like to thank them for accompanying and inspiring me. A little over four years have passed since the start of this journey; and while some passages were daunting and confronting, I gladly revisit their academic, social and personal merits.

First of all, I would like to acknowledge my promoter Andrew Vande Moere and co-promoter David Geerts. Andrew, thank you for guiding me through my PhD, and for asking so many questions along the way. Your methodological insights and creativity are impressive. I will look back on our collaboration with pride and satisfaction. David, thank you for encouraging and challenging me. Learning from you about human-centred design and qualitative research always happened efficiently and in such a calm atmosphere. I am also very grateful to Frank Vetere and Koenraad Keignaert, who also joined the examination board. Frank, thank you for hosting me at Microsoft SocialNUI and for introducing me to your fascinating studies. Koen, it was great to collaborate and to learn about your viewpoint as a sociologist. I thank the other members of the examination board for suggesting improvements: Florian Alt, Guido Geenen, Urs Hirschberg, Joris Klerkx, and chair Ludo Froyen.

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My research relied heavily on a large amount of urban residents, authorities and organisations that were willing to temporarily adopt a piece of technology and use it in whatever way they want. Even though they remain anonymous within this dissertation, their involvement was vital for my research. Thank you, and good luck in your future endeavours.

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1 Introduction

> *It's an ongoing challenge to see if media architecture can actually evolve into a place that allows for democratic voices to be shared.*
>
> **— Ben Rubin, 2012**
> (Media artist)

The increased ubiquity of information technology and computing infrastructure in the urban environment is influencing our experience of public space [Williams et al., 2009]. Nowadays, obvious examples include electronic screens in locations of human convergence, such as tourist hotspots, commuter hubs and cultural attractions. These new media in public space are promised to support various degrees of civic engagement, such as sharing information with locals, providing a platform for culture, or encouraging commerce [Struppek, 2010; Schieck et al., 2010; Fischer and Hornecker, 2012; Memarovic et al., 2013a].

The recent developments in display technology, building materials and interaction modalities resulted in new forms of hybrid architecture that have the ability to 'interact' with people and places. Commonly, this phenomenon is referred to as media architecture, i.e. various forms of interactive or dynamic displaying technologies that are integrated within architecture and the built environment, in order to passively or interactively broadcast information to their immediate vicinity [Dalsgaard and Halskov, 2010; Vande Moere and Wouters, 2012; Wouters et al., 2016a]. The definition of media architecture is leniently applied in order to encompass the architectural integration of electronic displays [O'Hara et al., 2008], dynamic lighting elements [Haeusler, 2009] and mechanical and electric actuators [Moloney, 2007; Garcia, 2007], in passive, reactive or interactive configurations.

Media architecture has the potential to elicit novel experiences onto our urban surroundings [McCullough, 2004]; such as by offering playful experiences [Fischer and Hornecker, 2012], increasing awareness on socially relevant topics [Valkanova et al., 2013], or seeking public and cultural engagement [McQuire, 2010]. However, research endeavours in the domain of media architecture were mainly driven by technical considerations such as the development of ultra-bright, fast responding lighting systems and control networks, or more intuitive interaction modalities. Hence, the social and architectural functions of media architecture have often been overlooked. In fact, the content, interaction, value and affordability of media architecture is often neglected and disconnected from the social reality in the immediate vicinity. As a result, while media architecture embodies a range of visually impressing and artistically compelling qualities, it often fails to create a relevant social and architectural experience.

- **Social Experience.** The capabilities of media architecture often fall short of connecting with the immediate audience, especially in terms of seeking active involvement in designing media architecture, in (co-)deciding the information that is shown, or

in stimulating useful engagement with media architecture for personal, strategic or social reasoning.

- **Architectural Experience.** Media architecture installations are still often agnostic of the expressiveness and layout of the surrounding built environment. As a result, the media and the architecture are often conceptually and physically disconnected, and media architecture struggles to move past its societal perception as a superfluous gimmick.

This dissertation is an inquiry into the design approaches that support further contextualisation of media architecture, in terms of rooting its design rationale within the local social and architectural fabric. The research is based on a design-oriented research methodology that combines architectural and participatory methods with those drawn from human-computer interaction. Our in-the-wild case are implemented in distinct public settings, to leverage high ecological validity in terms of revealing how people can be engaged in the design and usage of media architecture, and how media architecture has the potential to affect public spaces. Based on the case studies, we provide insights for designers, architects and urban planners for designing more contextualised forms of media architecture.

In this chapter, the research presented in this dissertation is introduced. First, media architecture as a new digital interface is situated within the broader historical context, and the main media architecture research themes are highlighted (Section 1.1). Next, we introduce our research approach, including the overarching research questions and the research methodology (Section 1.2). Ultimately, we provide an overview of the chapters of the dissertation (Section 1.3) and of the publications our work is based upon (Section 1.4).

1.1 Background

The new digitally augmented aesthetics of facades and public spaces aligns with historical precedents that engage architecture as a vehicle to communicate some form of iconography [Venturi and Brown, 2004]. For instance, sculptures enveloped Greek and Roman temples to communicate stories of heroism and religion [Spivey, 2013]; delicate enhancements in Gothic cathedrals conveyed *the great glory of God* [Brooke, 2016]; and the rich ornamentation of Baroque architecture exemplified triumph and wealth [Picon, 2014]. And even though the modernist aesthetic dictated that *less is more*, the historical importance of the ornament and iconography actually shifted to a more symbolic form of ornamentation through materiality, composition, colour and spatial experience [Venturi, 1977].

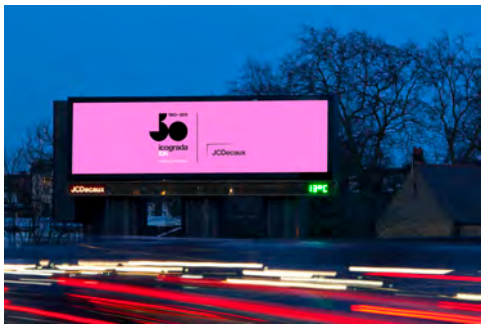
1.1.1 Historical Context

Since the 1990s, technological advances and increased affordability resulted in a dramatic proliferation of digital screens in Western society [Mitchell, 2004]. Times Square and Piccadilly Circus were long-time epitomes of digitally augmented architecture [McQuire, 2010], but electronic spatial effects now also appeared in a wide range of other manifestations, covering artistic (e.g. *Body Movies*[1], *BIX*[2] [see figure 1.1a]), entertainment (e.g. *Blinkenlights*[3] [see figure 1.1b]) and public broadcasting purposes (e.g. *JCDecaux* billboards [see

[1]Rafael Lozano-Hemmer, 2001, *Bodie Movies*, http://www.lozano-hemmer.com/body_movies.php
[2]Realities:United, 2003, *BIX / Kunsthaus Graz*, http://www.realities-united.de/#PROJECT,69,1
[3]Chaos Computer Club, 2001-2008, *Blinkenlights*, http://www.blinkenlights.net

(a) *BIX Media Facade*
(Photo © Museum Joanneum)

(b) *Blinkenlights*
(Photo © Wikimedia Commons)



(c) *JCDecaux*
(Photo © JCDecaux)

(d) *BBC Big Screens*
(Photo © Wikimedia Commons)

Figure 1.1: *BIX Media Facade* (a) and *Blinkenlights* (b) are examples of media architecture that wraps around buildings. *BIX Media Facade* provides Kunsthaus Graz with a screen that becomes an integrated part of the architectural skin; *Blinkenlights* is a light installation that transforms buildings into low-resolution screens. In contrast, public displays are often agnostic of architectural context. Their rectangular format renders them ideal to communicate commercial content (*JCDecaux*), (c) or local cultural content (*BBC Big Screens*), (d).

figure 1.1c], the now defunct *BBC Big Screens*[4] [see figure 1.1d]). Architecture gradually evolved into a carrier for *billboards of the Information Age* [Venturi and Brown, 2004].

A new kind of ornament arose out of electronically animated and computer-controlled displays. This evolution enabled the built environment to transform into a dynamic projection surface for large-scale and dynamic images that engage in a dialogue with their surroundings, such as by bringing playful experiences (e.g. [Brynskov et al., 2009; Fischer and Hornecker, 2012]), by facilitating new forms of public and cultural engagement [McQuire et al., 2009; Schroeter, 2012], or by extending traditional communication media platforms [Alt et al., 2011; Brignull and Rogers, 2003].

A next major evolution in the field of electronic displays occurred as LED (light emitting diode) technology matured beyond its previous monochromatic capabilities [McQuire et al., 2015]. Suddenly, screens could be operated at a remarkably lower operating and maintenance cost than their predecessors using incandescent light bulbs and CRT (Cathode Ray Tube) elements. Also, LEDs proved to generate sufficient brightness during both nighttime and daytime. In addition, the relatively small form factor of individual LED modules, increasingly allowed to also address the evolution in architectural design, from flat and rectangular surfaces, to complex and non-standard forms [Oosterhuis, 2002].

[4] BBC, 2002-2012, *Big Screens*, http://www.bbc.co.uk/bigscreens

The virtually endless technological possibilities allowed for media architecture to branch out. Its publicly accessible interfaces range from relatively small screens (i.e. *public displays*) to building-sized projection surfaces (i.e. *media facades*).

Public Displays. Also referred to as *urban screens*, public displays tend to be installed at points of human convergence, such as public transport hubs, public parks, and shopping districts. Their quality is to quickly convey local information to large groups of citizens [Schieck, 2005]. Public displays emerged as a powerful and ubiquitous communication medium that are deployed within a wide spectrum of application domains in order to promote advertising [José and Cardoso, 2011], address contemporary urban challenges [Schroeter, 2012] and enhance digital game experiences [Chatham and Mueller, 2013].

Media Facades. Recent technological advances allowed building facades to act more like independent building layers, creating the physical and conceptual space for carrying a range of display media that show moving images, graphics or text. Such manifestations, coined as *media facades*, are characterised by building-sized electronic displays that create moving, dynamic effects [Haeusler, 2009].

Within the context of this dissertation, the term *media architecture* is used to refer to any form of interactive or dynamic displaying technology that is situated in a public or semi-public, indoor or outdoor environment, with the typical purpose to share information with the general public. Most studies in this dissertation involve research on public displays, but the critical discussion of each study's results aims to generalise findings within the broader field of media architecture.

1.1.2 Research Context

The body of fundamental scientific research in the domain of media architecture is steadily growing. Most research is grounded within the fields of human-computer interaction (HCI) and urban informatics, but related core disciplines include engineering, computer science, communication science and architecture and urbanism, and stretch out to broader areas like economics, tourism, advertising, mobility optimisation, traffic safety, citizen participation, social innovation and public art. Gradually, technological research in the domain of media architecture shifts from optimising hardware issues to developing novel ways of user interaction, such as by way of 'natural' user interfaces that are invisible yet immediate and intuitive to use [Wigdor and Wixon, 2011]. Table 1.1 provides a summary overview of the current state of the art in seven closely related academic subdomains.

In recent years, research has recognised the qualities of integrating interactive features in media architecture, ranging from tactile sensitivity [Bohmer et al., 2011] and gesture recognition [Walter et al., 2013] to more recent advances such as analysing gender and facial expressions [Ravnik and Solina, 2013]. Interaction is not limited to traditional rectangular electronic screens but stretches as far as controlling urban lighting (e.g. [Seitinger et al., 2009; Poulsen et al., 2012]) and creating colourful effects onto media facades (e.g. [Boring et al., 2011; Brynskov et al., 2009; Hoggenmüller and Wiethoff, 2014]). We learn from these projects that integrating interactive features has the potential to enhance the experience of citizens in urban space.

The features and opportunities of interactive media architecture has motivated researchers to investigate and model how passers-by and viewers are stimulated to evolve towards en-

Table 1.1: Overview of research on various fields related to media architecture.

Subdomain	Theme	Key references
Hardware	**Overview**	[Schaeffler, 2008; Haeusler, 2009]
	Applications	[Gehring and Krüger, 2012; José et al., 2013]
	Networks	[Ten Koppel et al., 2012; Seeburger and Foth, 2012]
Interaction	**Design space**	[Brignull and Rogers, 2003; Müller et al., 2010; Michelis and Müller, 2011; Streitz et al., 2005]
	Methods	[Want and Schilit, 2012; Müller et al., 2012; Alt et al., 2012b; Ardito et al., 2015]
Content	**Typology**	[Veenstra et al., 2011; Hallema et al., 2016; Han et al., 2014]
	Context relevance	[Cardoso and José, 2009; Veenstra and Wouters, 2013; Wouters et al., 2013]
Social aspects	**Engagement**	[Schroeter et al., 2012; Schieck and Fan, 2012]
	User-created content	[Schroeter, 2012; Memarovic et al., 2013b]
	Ethics	[Langheinrich et al., 2013; Waycott et al., 2015]
Urban design	**Overview**	[Haeusler, 2009; Mediatecture, 2006; Dalsgaard and Halskov, 2010]
	Design process	[Kanis et al., 2013; Dalsgaard et al., 2008]
	Recommendations	[Brynskov et al., 2009; Fischer and Hornecker, 2012; Vande Moere and Wouters, 2012]
Economics	**Advertising**	[Schaeffler, 2008; Lundström, 2008]
	Audience potential	[Müller et al., 2009b]

gaged and motivated users (e.g. [Michelis and Müller, 2011; Brignull and Rogers, 2003; Fischer and Hornecker, 2012]). *Interactive Public Ambient Displays* is a technical model that allows a public display to automatically change mode and behaviour in response to the physical distance from its viewers [Vogel and Balakrishnan, 2004]. The various design decisions that are introduced, fulfil a role in drawing the viewer closer and letting the display phases evolve from *ambient display* (i.e. where viewers can quickly get an overview of the information space) to *personal interaction* (i.e. where viewers are able to interact with single information items, in order to retrieve more details). Similarly, mirroring the silhouettes of passers-by was identified to positively influence spectator engagement [Müller et al., 2012].

While *Interactive Public Ambient Display* focuses on the functionality of public displays, the *Audience Funnel* proposes a model that focuses on audience interaction, with a potential applicability within the realm of media facades [Michelis and Müller, 2011]. The model outlines the steps of viewer engagement, ranging from passing-by, viewing and reacting, subtle interaction and direct interaction, to one or more follow-up actions that can be expected. Both models highlighted the influence of the Honeypot effect, i.e. a social affordance that is characterised by a group of people interacting with a public display, that in turn attract new people to come closer and engage in an interaction [Brignull and Rogers, 2003]. The influence of urban spatial configuration has also been identified as a factor in motivating interaction, both with public displays and among citizens [Fischer and Hornecker, 2012]. Based on the analysis of two urban interventions that were deployed in a variety of urban settings, a terminology to describe interactive situations is proposed, by way of the *Urban*

HCI model. It takes into account the particular role and social behaviour of people in relation to (large) public displays. Applying the model allows for better situating public displays within the urban environment in order to provide comfort, room for interaction and space to 'activate' users (i.e. regions that allow people to view public displays without necessarily being aware of the supported or expected interactions).

However, despite the growing body of research on media architecture, advances were largely driven by technical considerations and interaction challenges. The social function of media architecture has often been overlooked, and the content, interaction, value and affordability of some media architecture installations are even completely disconnected from the social and architectural reality in their immediate vicinity. As a result, the vast majority of existing media architecture installations might be visually impressive but lack any notion of 'sociable' quality, in terms of the functional and architectural experience they create.

1.2 Research Approach

Our general research objective is to make architects, urban planners and designers more aware of the social and architectural potential of media architecture. The general research question is how media architecture can evolve into a contextually integrated medium that stimulates social interaction in its surroundings and integrates into the built environment.

1.2.1 Research Questions

The fundamental hypothesis of our research is that media architecture has the potential to become a place-making medium in public space. The main research question that this research aims to address is:

- **Q0**. How can media architecture stimulate and support social interaction?

In order to address the specific concerns that media architecture is confronted with, the research question has been dissected into five domains: content, engagement, integration, social relevance and architecture. For each domain one underlying research question emerged:

- **Q1 Architecture.** How can media architecture gain architectural relevance?
- **Q2 Content.** How can media architecture communicate locally relevant information?
- **Q3 Integration.** How can media architecture become more locally situated?
- **Q4 Engagement.** How can media architecture stimulate audience engagement?
- **Q5 Social Relevance.** How can media architecture gain social relevance?

These questions guide the overall research. We investigated each of them by drawing from several related disciplines (e.g. human-computer interaction, architectural design, social sciences), and answered the questions in specific contexts and through specific studies. Our motivation lies in delivering new insights that allow for the design of media architecture that is situated within its architectural context and that has local relevance. More specific research questions and goals are formulated in the following chapters.

1.2.2 Research Methodology

Upon starting this research, few studies had actively empowered citizens to reflect upon media architecture, such as its contents, interaction modalities, aesthetics or even the concept of more citizen-driven endeavours. As a result, we adopted an explorative and cross-sectional research approach by way of successive case studies, to allow for practical, empirical and reflective investigation of the research goals.

Since our research spans the fields of architecture and human-computer interaction (HCI) we adopted a threefold methodology, encompassing design-oriented HCI research [Schön, 1983], participatory design [Bødker, 1996], and in-the-wild evaluations [Rogers et al., 2007]. Each study involves the development of a critical perspective onto the results, in order to provide a comprehensive discussion that reveals relevant design implications, shortcomings and challenges, and opportunities for future research.

Design-Oriented HCI Research. We present four studies that integrate design of media architecture prototypes by way of hardware components, user interfaces and end-user applications. Ultimately, these prototypes were implemented and deployed in real-life settings. The development of the studies involved several research and design activities, such as literature review, contextual enquiry, ethnographic studies, participatory design workshops, and probing. We discuss how decisions were made throughout the design processes and the rationale behind them.

Participatory Design. Our studies actively involved stakeholders in the process of defining needs and requirements for prototypes, instead of prescribing solutions. By providing people with an opportunity to share their creative, critical and reflexive input, participatory design studies cultivate responsibility and ownership among citizens towards their outcomes [Brandt, 2006].

In-the-Wild Evaluation. Our studies were conducted in natural public settings, in order to benefit from a high ecological validity [Brown et al., 2011]. All prototypes captured some form of participation data logs, which were analysed together with field observations and responses to semi-structured interviews and questionnaires.

In one study (chapter 3), we invited architects to share insights on the qualitative experience of existing media architecture installations. This study is an exception to the overarching threefold methodology; instead, we favoured Q Methodology to combine qualitative and quantitative research methods, in order to examine subjective structures, such as opinions, attitudes, preferences and values [Brown, 1993].

1.3 Dissertation Overview

The dissertation is structured into three parts: Part I contains two studies that provide further detail to the significance of architectural context in media architecture (chapters 2 and 3). Part II presents four studies, which investigate the design and implications of media architecture to stimulate social interaction within its surroundings (chapters 4, 5, 6 and 7). Part III contains a summary of the various research contributions, a critical reflection on my work, an overview of design considerations, and a final discussion on the expected future state of the art (chapter 8).

Table 1.2: Relations between the individual chapters of this dissertation and the research questions they address.

Chapter	RQ1 *Architecture*	RQ2 *Content*	RQ3 *Integration*	RQ4 *Engagement*	RQ5 *Social*
2 Context	✓				
3 Quality	✓				
4 OpenWindow	✓	✓			✓
5 StreetTalk	✓	✓	✓		✓
6 Encounters	✓			✓	
7 Stories of Exile	✓	✓	✓	✓	✓

The relation between research questions and the studies that are presented in this dissertation is further clarified in Table 1.2. The importance of architecture is reflected in each study, with outcomes that range from acquiring theoretical understanding of architectural qualities to designing media architecture that is integrated within the design rationale of the surrounding built environment. Figure 1.2 visualises the role of architecture as a central theme throughout this research (Part 1), and the pivoting role of theoretical studies on context and architectural quality that helped in forming an understanding of the relationship between architecture and media architecture. The acquired insights from both studies were later applied in the subsequent case studies (Part 2). Ultimately, we combine our insights into a discussion on the contextual characteristics that support the social and architectural relevance of media architecture (Part 3).

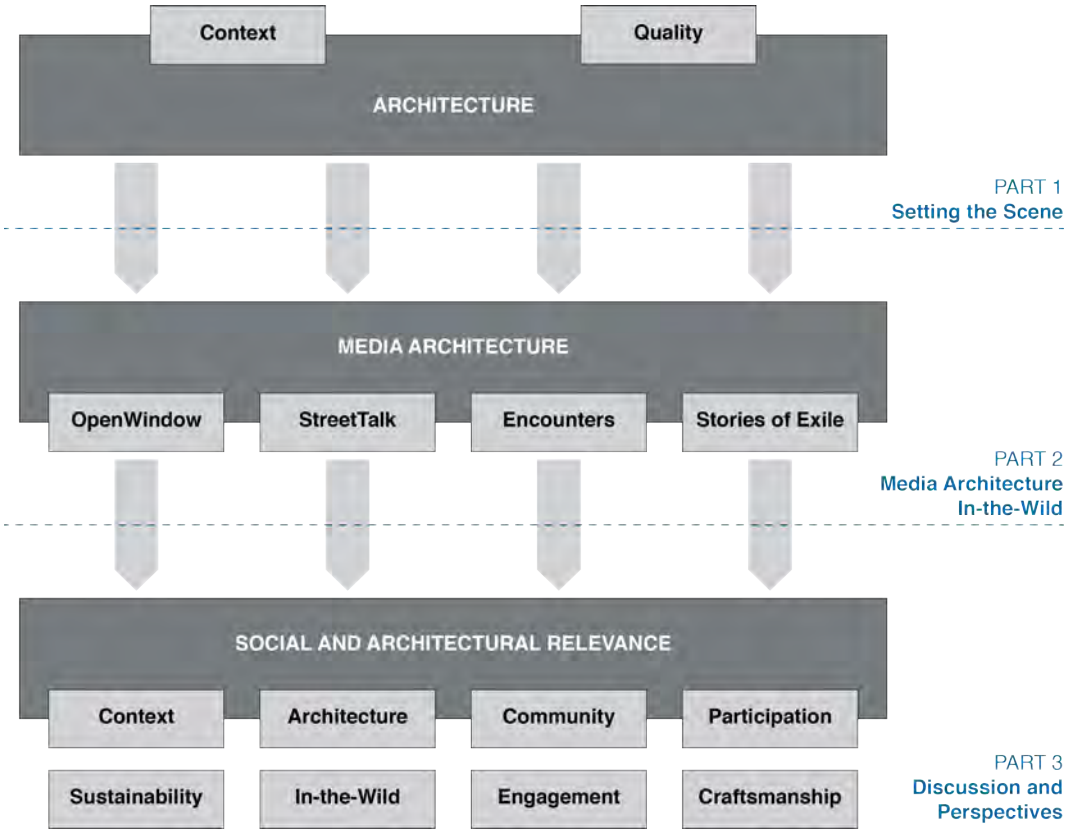


Figure 1.2: Relationship between the case studies and the key research themes.

1.3.1 Part I: Setting the Scene

The first part of the dissertation comprises two inquiries into the contextual and architectural qualities of media architecture. Both studies were developed early on in the research and were conceived to provide us with further understanding of the relationship between architecture and media architecture. Our results reveal key considerations to support the qualitative integration of media architecture into the urban fabric.

Chapter 2: The Context of Media Architecture. We build upon an analysis of existing media architecture installations to gain an understanding of the parameters that impact the integration of media architecture into the existing social fabric. Our analysis is founded on a range of semi-structured interviews with the relevant stakeholders in each of the analysed media architecture installations, i.e. Dexia Tower (Artist at *Lab[au]*, Executive at *Dexia Bank*, Architect at *Jaspers-Eyers Architects*), Media Screen Flagey Square (Artist at *Lab[au]*, Partner at *Belgian Posters*, Communications Officer at *Municipality of Ixelles*, Project Manager at *iMAL*), Beeld van Den Haag (Partner at *ngage media*) and AB InBev Display (Communications Officer at *AB InBev*, Architect at *Polo Architects*). Interviews aimed at uncovering views towards context-related symptoms that the installation was confronted with, how these were dealt with, and how it informed current practice. This study contributes:

- a model to describe *context* by taking into account the tangible and intangible influences that surround media architecture; and
- a set of guidelines for designing media architecture that is 1) sensitive towards the social-cultural aspects in its environment, 2) integrated within architecture and society, and 3) well-considered in order to continuously provide high quality content.

Chapter 3: The Architectural Quality of Media Architecture. In this study, we described which design qualities support the architectural relevance of media architecture. Our findings are based on a Q Methodology survey among 22 architects that revealed the perceived architectural quality of 24 existing media architecture projects. Participating architects were recruited among our existing network of contacts, but we required participants to have reached a mid-senior to senior level within the design firm. Among participating firms were some without any prior experience or interest in designing media architecture, as well as internationally recognised key players in the domain. Our study reveals:

- the applicability of Q Methodology within the field of human-computer interaction and the media architecture discipline;
- a novel terminology that architects employ to discuss the integration of media architecture within architecture.

1.3.2 Part II: Media Architecture In-the-Wild

The second part of this dissertation presents four studies that aimed to investigate design implications of contextualised media architecture. Next to addressing the key research questions, various methodological challenges were introduced in each case study, such as by selecting challenging real-life contexts for in-the-wild evaluations, or by purposefully opening up the prototypical design space of media architecture.

Figure 1.3: Chapter 4 (*OpenWindow*) illustrates the value of a more socially- and location-relevant integration of public displays in urban neighbourhoods.

Figure 1.4: Chapter 5 (*StreetTalk*) illustrates how public displays facilitate communication and interaction between households and their local neighbourhood.

Figure 1.5: Chapter 6 (*Encounters*) investigates the trajectories and influences of audience engagement in public interactive installations in order to gain an understanding of contextual, spatial and social factors that influence engagement.

Figure 1.6: Chapter 7 (*Stories of Exile*) investigates the potential of media architecture to serve as an intercultural interface between distinct communities in public space.

Chapter 4: OpenWindow. In this study, we investigate the 'public' potential of public displays by shifting the responsibility to control content from central authorities to citizens. While we initially aspired to gain access to an existing, large public display and engage nearby residents in the content control process, various political and technical reasons prevented us from doing so. Hence, we designed and deployed small public displays in three separate houses and invited households to provide their own content (see figure 1.3). Participants were recruited through community organisation *Opsinjoren* that works together with the Antwerp city council. Subsequent participant selection was based on socio-demographic composition of the neighbourhoods of residence, in order to cover three distinct urban profiles. After concluding the study we conducted 30 semi-structured interviews with nearby residents to uncover opinions about the small public displays, the content they showed, and the opportunities for social interaction they created, as well as a questionnaire to deliver insight into the sense of community. Our insights are based upon the interpretation of interview transcripts, on-site observations, message logs, and a representative sample of video footage from webcams that were built into the public displays. Our study reveals:

- the design rationale and functionality of a set of citizen-controlled public displays and their subsequent in-the-wild evaluation; and
- implications of allowing citizens to control content on public displays and media architecture, particularly in terms of social interaction in the neighbourhood.

Chapter 5: StreetTalk. In this study, we describe the design and evaluation of a set of a set of situated public displays that were attached to house facades to facilitate communication and interaction between households and their local neighbourhood (see figure 1.4). Similar to *OpenWindow*, we collaborated with community organisation *Opsinjoren* to recruit participants in various neighbourhoods of Antwerp. During home visits, participant households collaboratively designed neighbourhood communication concepts during a participatory *LocaLudo* workshop (Huyghe et al., 2014). We conducted 10 design workshops with households in six different neighbourhoods, and finally selected three households. Our insights are based upon the analysis of interaction logs, observations during site visits while the study was ongoing, and semi-structured interviews with 10 nearby residents and the three participant households. Our study reveals:

- the design rationale of a set of participatively designed public displays and their in-the-wild evaluation;
- the concept of *hyperlocality* as a new way of delivering locally relevant and socially situated content on public displays; and
- a set of design recommendations for future endeavours in the realm of situated public displays.

Chapter 6: Encounters. In this study, we provide further context to the honeypot effect, i.e. the effect of passers-by moving closer to an interactive installation after observing others interacting. Our results and findings are based upon the analysis of *Encounters*, a public installation that interactively translated bodily movements into a dynamic visual and sonic output (see figure 1.5). We studied interaction logs and feedback from 125 semi-structured interviews that were collected during four separate runnings of *Encounters*. Questions were open-ended, and aimed at uncovering the experiences of people: why partici-

pants felt motivated or discouraged to interact on stage, how participants learnt about the interaction possibilities, how dancers perceived the collaboration with participants, and how volunteers interacted with passers-by to encourage them to participate. All interview notes were later sorted by a representative sample of researchers, dancers, visual artists and software engineers that were involved in the design, development and execution of *Encounters*. Our study contributes:

- the Honeypot Model as a spatiotemporal model that describes the relationship between user roles, trajectories, influences and triggers in interactive systems; and
- scenarios that suggest the potential usefulness of the Honeypot Model in interactive installations, by describing how particular spatial, social and interactive elements affect the success of trajectories and influences.

Chapter 7: Stories of Exile. In this study, we investigate the potential for media architecture to become an intercultural interface in public space, that stimulates interaction between community members and refugees (see figure 1.6). Our analysis is founded on observations and semi-structured interviews. Two researchers observed and took notes about the behaviour of citizens and refugees within the space. In addition, 12 semi-structured interviews allowed people to express feelings that *Stories of Exile* provoked with them, along with their understanding of the current refugee crisis. The main themes from interviews emerged through a process of selective coding. Our study contributes:

- the conceptual and technical implementation of *Stories of Exile*, including the participatory design process with refugees and the in-the-wild evaluation of the resulting interactive projection mapping; and
- further understanding to the new challenges that contextually embedded and socially relevant media architecture introduces.

1.3.3 Part III: Discussion and Perspectives

In the third and last part of this dissertation we reflect on the methodology and our research outcomes. We revisit and discuss the general contributions of the dissertation, and offer a critical perspective on media architecture, our methodology and our studies.

1.4 Publications

The main body of this dissertation consists of research that appeared in academic publications over the course of the doctoral research[5]. These publications contain research contributions in their own right and were evaluated through peer-review. The publication that is referenced in chapter 7 will be submitted to a conference venue at a later date, and was thus not yet peer-reviewed. Each paper discusses state of the art and related work, research questions, arguments and analysis for a particular case or theme.

Chapter 2: Study I. Andrew Vande Moere and Niels Wouters (2012). The Role of Context in Media Architecture. In *Proceedings of the International Symposium on Pervasive Displays 2012*

[5] A complete overview of publications, including those not included in this dissertation, can be retrieved from http://nielswouters.be/archive.

(PerDis '12). ACM, New York, NY, USA, paper No. 12. http://doi.org/10.1145/2307798.2307810

Chapter 3: Study II. Niels Wouters, Koenraad Keignaert, Jonathan Huyghe and Andrew Vande Moere (2016). Revealing the Architectural Quality of Media Architecture. In *Proceedings of the Media Architecture Biennale 2016 (MAB '16)*. ACM, New York, NY, USA. http://dx.doi.org/10.1145/2946803.2946808

Chapter 4: Study III. Niels Wouters, Jonathan Huyghe and Andrew Vande Moere (2013). OpenWindow: Citizen-Controlled Content on Public Displays. In *Proceedings of the International Symposium on Pervasive Displays 2013 (PerDis '13)*. ACM, New York, NY, USA, 121–126. http://doi.org/10.1145/2491568.2491595

Chapter 5: Study IV. Niels Wouters, Jonathan Huyghe and Andrew Vande Moere (2014). StreetTalk: Participative Design of Situated Public Displays for Urban Neighbourhood Interaction. In *Proceedings of the Nordic Conference on Human-Computer Interaction 2014 (NordiCHI '14)*. ACM, New York, NY, USA, 747–756. http://doi.org/10.1145/2639189.2641211

Chapter 6: Study V. Niels Wouters, John Downs, Mitchell Harrop, Travis Cox, Eduardo Oliveira, Sarah Webber, Frank Vetere and Andrew Vande Moere (2016). Uncovering the Honeypot Effect: How Audiences Engage with Public Interactive Systems. In *Proceedings of the Conference on Designing Interactive Systems 2016*. ACM, New York, NY, USA. http://doi.org/10.1145/2901790.2901796

Chapter 7: Study VI. Niels Wouters, Sandy Claes and Andrew Vande Moere (2017). Stories of Exile: Media Architecture as a Situated Interface Between Refugees and Local Community Members. To be submitted.

Part I

Setting the Scene

2 The Context of Media Architecture

This chapter has been previously published as:

Andrew Vande Moere and Niels Wouters (2012). „The Role of Context in Media Architecture“. In: *International Symposium on Pervasive Displays 2012*. New York, NY, USA: ACM, Article No. 12. DOI: 10.1145/2307798.2307810

My contributions:
This study was mainly motivated by the first author, Andrew Vande Moere. We have developed a model to describe the context of media architecture, and selected appropriate case studies to describe the model's attributes. I have taken the lead in analysing the symptoms of each case study, in order to reveal the effect of contextual characteristics on media architecture. The publication was co-authored by Andrew Vande Moere and myself.

Significance and value:
The findings from this study highlight the challenges inherent to integrating media architecture within the built environment. Our guidelines reveal the need for operators and designers of media architecture to collaborate with architects and urban planners. Our findings must allow for context to become an intrinsic part of the design process, and enhance its general credibility and sustainability.

Study limitations:
Our analysis is rooted in the underexposed architectural discourse in research on media architecture at the time of writing. Hence, the model should be considered as a first and explorative representation that allows to dissect and analyse manifestations of media architecture in its main core elements. The model, with the terminology and the accompanying figure, is an abstraction that can be directly applied equally to media facades and public displays, but can evenly be applied to more spatial and embedded forms of media architecture. The model has been a starting point for our research. The notion of context has been further established in the subsequent studies, leading to the identification of additional characteristics (see Section 8.2.1: Significance of Context).

2.1 Abstract

In this chapter, we investigate the contextual characteristics of media architecture – parameters that impact its integration in the existing social fabric – from a socio-demographic (*environment*), technical (*content*) and architectural (*carrier*) perspective. Our analysis draws upon four real-world examples of media architecture, which have been specifically chosen to demonstrate a prototypical range of context-related symptoms, including a deliberate case of vandalism, the disconnection of a building-wide lighting installation, or the inappropriate integration of a screen on an existing architectural facade.

In spite of its intrinsic 'dynamic' character, we conclude that media architecture seems not well prepared to adequately respond to changes in its context over time. As a result, we propose a set of guidelines that target all relevant stakeholders, ranging from architectural designers to content managers and public authorities, in an aim to improve media architecture's acceptance and credibility, towards its long-term sustainability in our urban fabric.

2.2 Motivation

The purposes of an architectural facade are multifold: next to its traditional function as a protective layer for preserving privacy and against climatic influences, it also represents a building's cultural era and societal role. As such, a typical facade is subject to both cultural and architectural styling, codetermining the perception of the building within the context of its location, considered on the scale of the street, the district or even the whole city [Schittich et al., 2006]. Recent technological advances have allowed a facade to become separated from the load-bearing structure and to act more like an independent skin, creating the physical and conceptual space for carrying a range of external media, such as lighting and screens (e.g. showing moving images, graphics, text). Next to the changing nature of architectural facades, an increasing number of electronic displays are becoming embedded in the contemporary urban environment, ranging from simple advertising surfaces to dedicated screens in trams or buses. We thus define media architecture as a field that comprises physical structures that utilise digital media to passively or interactively broadcast information to their immediate vicinity. The majority of existing media architecture seems to serve commercial, artistic or entertainment purposes, but its cultural [McQuire et al., 2009], social [Bullivant, 2007; Garcia, 2007], and technological [Haeusler, 2009; Mediatecture, 2006] qualities have motivated its proliferation.

Our physical environment, in its ability to shape and represent the local standards and rules of social interaction, plays a crucial role in the construction and reflection of social behaviour. For instance, moving through the city has always been a performative practice where the citizen interprets the surroundings for his own purposes and enjoyment [Galloway, 2004]. Therefore, media architecture should avoid imposing any specific experience that fails to harmonise with the existing fabric, or to create an artificial reality on her own terms. Therefore, we believe that new knowledge is required to allow architects and urban planners to understand the full potential of 'interactive' systems over that of 'reactive' systems, so that the integration of media technology in our built environment will not suffer from the visual blindness and emotional disconnection that we know from current forms of public advertising. Here, interaction is interpreted beyond the direct man-machine loop and incorporates the indirect input of, and the influence on, the whole social, economic and urban context that surrounds media architecture. Through its public dimension, media architecture has the ability to reach beyond its obvious functional aspects, which it has in common with other human sciences. Through its particular way of expressing values, media architecture has the potential to stimulate and influence social life without necessarily presuming that it will promote social development.

This chapter analyses the contextual integration of media architecture within the social and societal settings that exist within the urban fabric. It aims to develop a theoretical foundation that allows it to transcend from a technological 'gadget' into a meaningful place-making medium that augments the architectural and urban qualities of a public space. The results of this research provide the first indications of the challenges that exist in successfully integrating media architecture in the urban fabric, in terms of media architecture's 1) immediate

and situational environment, 2) its physical carrier, and 3) the content it displays, as well as the transformation of these three aspects over time.

2.3 Background

Media architecture has been promised to facilitate new patterns of use and socialisation, by forming a relatively novel medium for interaction in public spaces [Brignull and Rogers, 2003] and the urban environment [Brynskov et al., 2009; Willis et al., 2010]. The most obvious value of media architecture is its ability to augment social cohesion by acting as a conversation starter [Agamanolis, 2003; Bohmer and Müller, 2010; Rubegni et al., 2011] and by increasing identity cognition and community feeling through the creation and sharing of content [Memarovic et al., 2011], resulting in the reinforcement of people's social identity and civic pride [Macmillan, 2006]. Media architecture is therefore often seen as a catalyst to influence frequency and quality of social activities in public space [Gehl, 2010].

Due to the challenging nature of embedding technology within a varying social-cultural, public setting, designers should examine and explore the implications of the cultural influences that are inherent in design instead of articulating the implications for design that follow from some understandings of the social [Dourish and Bell, 2011]. This implies that, in order for media facades to become better accepted in our society, its contextual parameters should be considered prior, and not consequent, to its design. One proposed approach towards increasing contextual integration to stimulate social interaction is by embedding *context-awareness*, i.e. a display's ability to deliver 'the right information at the right time' [Cardoso and José, 2009]. This approach focuses on the technical recognition of human interaction patterns (e.g. presence detection, content suggestion), enabling the display to adapt its behaviour to the specific characteristics of its social setting.

The role of context-awareness has been further investigated in a *Design Space Explorer* [Dalsgaard et al., 2008], which structures the aspects of material, form, location, situation, interaction, content, purpose and experience as possible scenarios to optimise design concepts, and align all project stakeholders. This topic has been further discussed in eight challenges for designing media facades [Dalsgaard and Halskov, 2010], including considerations on integrating screens in the existing environment, on delivering suitable content (in terms of the medium and the interactions required) and on designing for a diversity of situations that might occur in the environment. We build upon this research to describe context from a single model that encompasses the tangible as well as intangible influences that surround a media architecture installation, and base our findings on a set of existing, real-world examples. As a result, we focus on the social and societal values of public media interventions, and will conclude how these seem still to be undervalued in the media architecture practice.

2.4 Analyzing the Context

In order to address specific issues in the practice of media architecture, we argue that its contextual integration should be investigated from three different perspectives (see figure 2.1): that what is *in front of*, *on* and *behind* the public display device or, respectively, 1) the environment in which the media architecture is implemented, 2) the actual content that is being communicated, and 3) the carrier that supports the display medium.

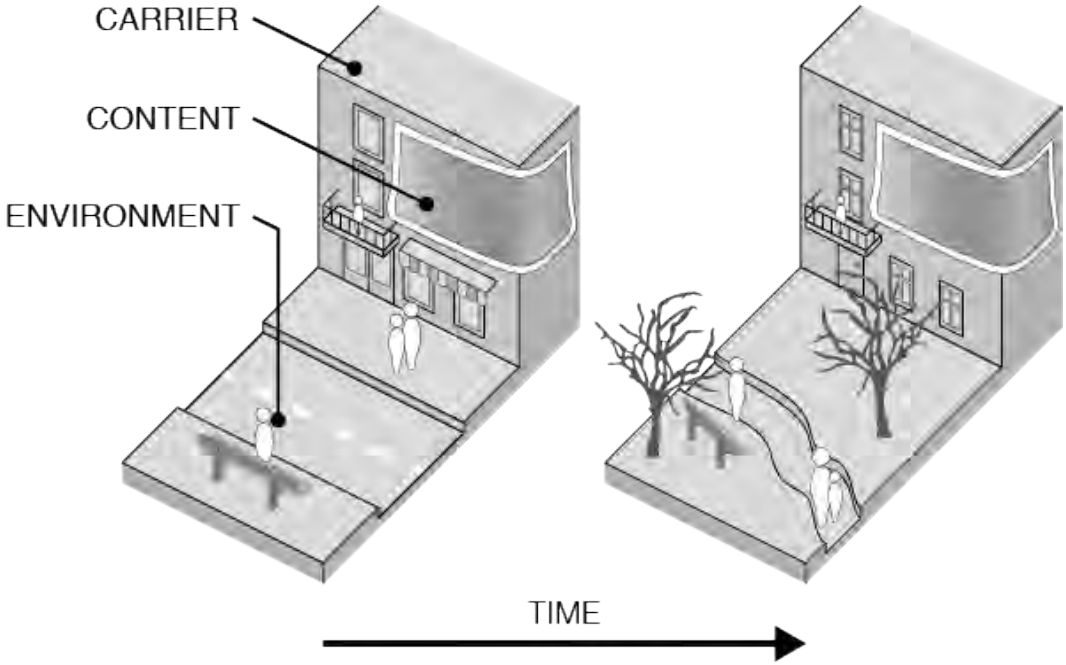


Figure 2.1: The potential change of context over time, in terms of carrier, content, and environment; resulting in the question how media architecture can adequately respond.

Environment is the immediate vicinity, comprising of the physical reality (e.g. buildings and materiality) as well as the people and their activities. Notably, this concept also uses less tangible parameters that describe the setting's actual condition, such as the socio-demographics, culture and overall atmosphere.

Content stands for the information that is shown, and includes any interpretation that might be generated from it. This concept consists of both the messenger (the technical means that are required to broadcast the information in the public realm; e.g. LED lights), and the message (the literal representation and its implied meaning or interpretation).

Carrier includes those elements (e.g. a building, a square, a facade or ornament) that fulfil a supporting role in sustaining the broadcast medium, be it for structural, functional, or aesthetic reasons. Through the societal perception of its presence, a carrier has the potential to expand the expressiveness or even steer the interpretation of the content it displays.

Although the three contextual characteristics are closely intertwined, we claim that each plays an independent role in understanding the context that surrounds a particular media architecture installation. For instance, the same content (e.g. the number of passing bicycles) conveyed in the same environment (e.g. city neighbourhood), may be interpreted differently for a different carrier (e.g. facade of an environmental organisation's headquarters vs. that of a hospital). Similarly, showing identical content (e.g. luxury product advertising) on an identical carrier (e.g. bus stop) will result in a different understanding for a different environment (e.g. situated in a shopping quarter vs. an impoverished neighbourhood).

In addition, many transformations of the urban environment over time are likely to impact the context of a media architecture installation. For instance, an architectural adjustment of the carrier (e.g. providing more voids in a facade, affecting the mounting possibilities for display devices) is likely to result in modified contents (e.g. displaying several separate

commercials instead of one large-scale advertisement). Likewise, a future change in displayed contents (e.g. commercial content instead of relevant public messages) may result in altered perception towards the display's carrier (e.g. disinterest from nearby residents towards the building's owners). This hints at media architecture's intrinsic dynamism, unlike the predominantly static nature of architecture.

2.5 Case Study Analysis

We present four real-world cases that demonstrate the different dimensions of media architecture's context. Each case has been specifically selected to be of relatively consistent size, content and scale. The description and analysis of each case is founded on a series of open-ended interviews with respective stakeholders, such as the professionals involved in the design process, the interaction designers and the content managers.

The environmental situation was analysed through observations during in-situ visits, the consultation of relevant press reports, as well as open-ended interviews with residents and passers-by. Each so-called 'symptom' situates a specific contextual issue that has been observed by either a stakeholder we interviewed, or has been reported by third-party sources like newspapers or online blogs.

2.5.1 Media Screen Flagey Square, 2008

Environment. This LED screen, operated by *Belgian Posters*, is located in a corner of a large public square in the agglomeration of Brussels, Belgium. This particular municipality is characterised by a high percentage of foreign origin inhabitants (87% vs. 22% nationwide, 2008), and higher than average rate of unemployment (17% vs. 8% nationwide, 2010).

Carrier. The screen forms part of a public square that fulfils an important local social-cultural purpose, and as a shared outdoor area for local residents.

Content. The LED screen, oriented towards the open square, has a 12m^2 display area, at a resolution of 320 *x* 240px. On rare occasions, the screen has been used for film screenings or festivals , such as the Media Facades Festival Europe 2010[1]. However, the content is mostly delivered to the operators by the municipality, resulting into announcements of cultural or municipal interest, such as about events in upper-class shopping streets, or information about the local parking policy.

Symptom. This screen stands out for at least three press-reported acts of vandalism[2]. In 2009, the electronic cabling was set on fire, and on two separate occasions the screen was covered in paint (see figure 2.2). The arson was followed by an anonymous poster campaign that mentioned '*we will resist any commercial invasion*' and negatively referred to the '*praising of luxury shops*'.

[1] http://www.imal.org/en/activity/media-facades-festival-europe-2010
[2] http://www.brusselnieuws.be/artikel/reuzenscherm-flagey-slachtoffer-van-vandalen

Figure 2.2: Vandalised media screen on Flagey Square, Brussels.

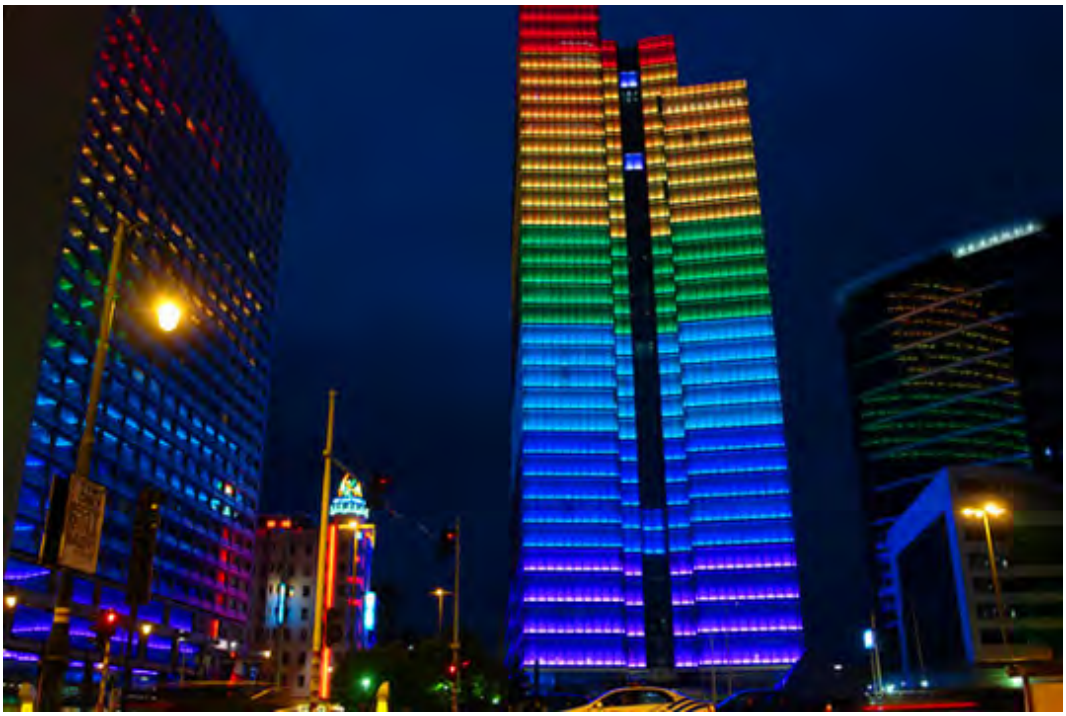


Figure 2.3: Dexia Tower, Brussels displaying the *Weather Tower* art installation, turning weather data into abstract form.

Figure 2.4: LED screen mounted on AB InBev's headquarters in Leuven, Belgium.

Figure 2.5: Integrated LED screen mounted on *Het Strijkijzer* in The Hague, The Netherlands.

2.5.2 Dexia Tower, 2006

Environment. The *Dexia Tower* skyscraper is located in a major business district near the centre of Brussels, along one of its main access roads. The area is sparsely populated, and at night often plagued by crime and violence.

Carrier. The 145m tall high-rise houses the global headquarters of one of Belgium's major banks and its subsidiaries. Because of its physical and visual prominence, the building acts as a widely recognised landmark in the city (see figure 2.3).

Content. Each of the 4,200 windows has been equipped with 12 RGB LED-lights that are individually controllable, resulting in a total resolution of 160 *x* 45px, wrapped around the building's facades [Lab, 2010]. The lighting concept, developed by the lighting design studio of Barbara Hediger, aimed at visualising dynamic and abstract messages with a large urban impact. Accordingly, the tower has been the subject of several artistic media installations, mostly initiated by the interdisciplinary Brussels-based design office *Lab[au]*.

Symptom. In 2008, the *Dexia Tower* display has been turned off, except for a sporadic 10-minute animation that essentially consists of the default demonstration of the original hardware installation. Interviews with the media installation's designers revealed that the 2008 financial crisis (and the dramatic collapse of the *Dexia Group* in 2011), has led the bank to conclude that the societal perception towards the company had fundamentally changed.

2.5.3 AB InBev Display, 2009

Environment. The screen is mounted on a modern office building located in an old, but fully redeveloping industrial site at the northern edge of Leuven, Belgium. Notably, the screen was installed four years after the inauguration of the building.

Carrier. The building houses the global headquarters of the world's biggest brewer, *AB InBev*. Mounted in the top left corner of its northwestern facade (see figure 2.4), the screen is perpendicular to a busy ring road that runs alongside. The brick building is characterised by a strong architectural language, which reflects the former industrial environment.

Content. The 3.2 *x* 6.7m LED display offers a resolution of up to 160 *x* 336px. *AB InBev* manages the content, which primarily consists of their televised beer commercials or the company logo.

Symptom. The building's lead architect was not involved in deciding upon the placement of the screen. He stated the screen's location on the facade seems aesthetically out of place in comparison to the proportionality and the grid-like layout of the building's features, silhouette, windows and voids.

2.5.4 Beeld van Den Haag, 2010

Environment. The 132m *Het Strijkijzer* (*The Iron*) skyscraper is located next to the main train station of The Hague, The Netherlands, and adjacent to a main access road.

Carrier. The building contains mainly apartment units, and stands prominently apart for its height in an environment otherwise characterised by low-rise housing. The screen itself is located on an 80m high horizontal volume of the northeast facade, that is facing away from the train station (see figure 2.5).

Content. The 266m^2, 1024 *x* 768px LED display consists of a series of horizontal LED strips that are architecturally integrated on the inside of the building because of installation comfort as well as legal issues (as it became an interior projection). Since late 2011, when content management company *Ngage Media* took over responsibility, the screen aims to function as a 'public notice board' and a 'situated display' that responds to relevant and timely events in its immediate vicinity.

Symptom. Five months after inauguration, the display still shows mostly traditional ad commercials, and little to no 'contextual' content. The most obvious reason, as mentioned by the content provider, is that advertisers are currently still inexperienced with the concept of contextual advertising shown on a public display.

2.6 Discussion

The four case studies are discussed as a function of the contextual characteristics we have proposed in section 2.4 (*Analyzing the Context*), in order to analyse and learn from each project's contextual symptoms.

2.6.1 The Role of the Environment

The vandalism that occurred at the *Media Screen Flagey Square* reveals the contrasting interests of media architecture and its local environment, and how it should be sensitive towards the social-cultural environment that surrounds it. Notably, a public environment's social-cultural context evolves over time; if not over decades in terms of population turnover, then at least during the timespan of an ordinary weekday: as work commuters might be considered as the ideal audience for advertisements about a specific luxury event or a skin revealing product, the same message might be interpreted as uninformative and even provocative for those 'users' that actually inhabit and use the environment during the many hours when commuters have left.

Investigations on context-awareness in media architecture are often limited to recognising 'users' by their physical or social characteristics (e.g. age or gender, counting people [Cardoso and José, 2009]) or their activity patterns (e.g. collective action by participants, dialogue, shared focus, distributed attention [Ludvigsen, 2005]). Yet, context might well involve intangible or tacit aspects that are relatively complex to computationally capture or evaluate, such as religious beliefs, financial purchasing power or employment status. Content creators should thus become more conscious of the impact of the social-cultural context, for instance by surveying or actively involving the inhabitants to determine, or at least agreeing on, the content shown. The value of citizen participation should be particularly obvious for the content shown during those times of day that the local population is the only recognisable 'user'.

Inhabitant participation also has the ability to empower citizens to create an impact on their own environment. For instance, for the *Media Screen Flagey Square*, local residents were dismissive about the messages that related to a financial or cultural reality that did not correspond to their own, although they were enthusiastic about a series of interactive artworks displayed during a recent *Media Facades Festival*. The most frequently mentioned appraisals were the works' surprising and funny nature, the possibility for all age groups to engage and participate, and their complete dissociation from a specific social-cultural background.

One can therefore imagine that the design of media facades and their content should be motivated by, and founded on, a detailed analysis of the existing social-cultural fabric. While the official approval for architectural or urban interventions always involves some sort of site analysis, the same might be made applicable for media architecture, which holds the potential to have a similar, if not greater, impact on the environment than the physical building itself. Such an initiative may necessitate the approval of a validated methodology, the involvement of advisory media architecture commissions that include local stakeholders, or the mandatory inclusion of easily accessible feedback loops that allow the local population to voice their concerns or propose changes.

Design Consideration. Ensuring the 'acceptance' of media architecture involves becoming sensitive to the social-cultural reality in its immediate vicinity, in addition to how this reality evolves over time (from minutes to decades). Next to appropriate analyses, this sensitivity might involve the active involvement of the local population, or at least the inclusion of explicit feedback channels of the 'users'.

2.6.2 The Role of the Carrier

While most media architecture research focuses on the content or technological advances that enable the architectural display, the role of the 'carrier' of the media should not be overlooked.

Architectural Integration. By way of its wide-ranging and aesthetic appeal, the elegant architectural integration of media architecture plays an important role in determining the perceived quality of its physical surroundings. The lack of architectural integration of *AB InBev*'s display can be largely explained by its installation well after the building's completion date, and the exclusion of the original architect during its conception. This case therefore demonstrates the responsibilities of architecture (in terms of design rationale) and urbanism (in terms of regulation) in the emerging media architecture phenomenon, even by proactively engaging the possibility that some sort of media installation might be added well after the full construction of a building or a neighbourhood. This issue might even be more apparent for a building that exemplifies an exceptional architectural quality: making any well-suited media addition to a strong, expressive or well-balanced layout is considerably more complex than mounting a rectangular surface on the largest open space of the facade that is available.

Therefore, we propose that research should involve new ways to make architects and urban designers actively aware of both the opportunities and complexities of integrating media architecture in an existing physical context. Such an introduction should be sensitive to both best-of-practice as well as less successful examples, and clearly define the responsibilities of

all building stakeholders in terms of media architecture, even when no media architecture was originally planned.

Design Consideration. Ensuring the 'architectural' quality of media architecture involves the pro-active consideration of its potential presence during the planning of architectural or urban interventions, even when it is not yet planned or even anticipated by the stakeholders.

Societal Integration. The impact of media architecture reaches beyond its manifestation in public space, and should incorporate its presence within a broader, societal reality. For instance, the radical decision to disconnect the media facade of the *Dexia Tower* has demonstrated that in spite of no physical, contextual changes on the site, the perception of the carrier had a dramatic and decisive impact on the media architecture. The *Dexia Tower* is in itself just a building, but also acts as one of the main public representations of a banking institution, which unfortunately includes all the subjective connotations that have dramatically changed in recent years.

The impact of public perception on media architecture reveals a gap between the inherent timelessness and robustness of architecture, which does not allow any action that is similar to 'turning something off' (with the exception of demolishing a building or abandoning the premises), versus the quite casual act of removing the content on a display medium. It also highlights the current apparent public perception of media architecture as a gadget, a purely aesthetic embellishment that can be easily turned off, regardless of its architectural and spatial experience for which it was originally conceived, funded and built.

These observations are in contrast to the belief that media architecture should be fully integrated, that is become an almost indispensable part of the architectural quality of a building, and the urban fabric it co-determines. Turning off media architecture has wider implications than making it invisible to the outside world. It has an impact on at least the social, cultural, economic, architectural and urban scale, such as in neglecting the opportunity to convey a public message (social scale), removing the opportunity to act as a canvas for artistic expression (cultural scale), impacting the revenue of businesses that might rely on its place-making abilities (economic scale), denying the responsibility to continue to add value towards the experience of the space it determines (architectural scale), and dismissing its position in the city as a persistent orientation point for residents, tourists and commuters alike (urban scale). Moreover, as the Dexia Bank has understandably only metaphorically meant to revert back to its 'core' business, it has now become a real challenge to overcome such loaded motives when the media architecture will ever be switched back 'on': should this then be interpreted as reverting back to its non-core business?

The core of this issue is determined by the societal perception of media architecture as a superfluous gimmick, in particular in terms of not appreciating the broader role of media architecture. More research is required to determine the real impact of media architecture in all its facets, to be able to demonstrate its true social value that reaches beyond providing the public with dynamic forms of light emissions. Here, media architecture could potentially benefit from the concepts and theories of architectural sustainability [Williams, 2007] in order to optimise its lifespan: for instance, media architecture should allow for flexibility in setup and use, thereby transcending any initially prescribed forms of ownership and inhabitance of the building. This could be outlined in voluntary but interminable commitments or building regulations, issued and monitored by public authorities.

Design Consideration. Ensuring the 'durability' of media architecture involves objectively determining its true impact in society beyond its obvious visceral and visual effects, involving, but not limited to, its social, cultural, economic, architectural and urban implications. Such an analysis should also consider how potential societal changes over time might influence these implications.

2.6.3 The Role of Content

The inherent 'dynamic' nature of media architecture suggests its use for innovative approaches in terms of the contents it can display. However, immediately after its inauguration, the operators of *Beeld van Den Haag* were confronted with an absence of content and readily available mechanisms that allowed alternative usages of the display. This lack of content ultimately resulted in the temporary discontinuation of the screen. Remarkably, the act of disabling a new media architecture installation for a lack of content contrasts the detailed care and relatively long timespan that is required to conceptualise, receive permission for, fund and construct it. One may wonder if media architecture can really become an intrinsic part of the architectural or urban fabric, if the management of its contents is treated as an afterthought during the building's comprehensive development process. The later involvement of content managers relaunched the *Beeld van Den Haag* display, which resulted in the temporary measure of displaying traditional televised commercials and public messages (e.g. time of day, weather forecast, tweets about Den Haag). However, it is still the question how we can measure the 'quality' of media architecture's content, and how the perception of its quality might affect its impact, ranging from its social acceptance to the architectural integration.

We argue that new methods or tools are required to overcome the obvious availability and quality issues with content, in particular for media architecture that reaches beyond the broadcasting of commercial messages. Ideally, such methods or tools should be applied well before its actual construction, and be sufficiently robust to guarantee the continuity of content throughout the total lifespan of media architecture. The obvious stakeholders in media architecture encompass at least its designer, the carrier's owner and designer, and those involved in its content design and maintenance. Architects may ask the power or need guidelines on how to optimally co-determine the content while respecting the carrier's architectural expression, whereas operators and owners may wish for ways to overcome repetition and to assure the appropriate message for the right people. The 'users', i.e. inhabitants and passers-by alike, should become more involved in voicing their opinions in what the content should, or should not, consist of. Such methods might include ways to analyse and foresee how such 'users' are likely to perceive media architecture, and should test the validity of assumptions on how content is experienced by actual people in real life. Taking into consideration an open communication of all the motives of the stakeholders should lead to content that positively contributes to the carrier's architectural value, causing a positive reception from people, while still maintaining a healthy commercial revenue.

Design Consideration. Ensuring the 'quality' of media architecture involves a considerate and open approach that takes into account the motives of all stakeholders, inclusive of the aesthetic wishes of the architect, the commercial intentions of content managers, and the subjective concerns of 'users'.

2.7 Chapter Summary

The 'symptoms' that were mentioned and analysed in this chapter involve the apparent inability of media architecture to adequately respond to contextual changes in its environment, its carrier or its content. More specifically, the cases show how media architecture can be vandalised due to *changes* in social-cultural sensitivity of its passers-by; can be misaligned in a distinctive architectural grid due to its installation well *after* the building's completion date; can be disconnected due to a drastic *change* in the societal perception of its carrier building; and can display no, or no original, content due to a lack of *timely* planning. Despite the inherent and highly esteemed 'dynamic' character of media architecture, that is its theoretical ability to show anything, at any given point in time, on any sort of surface, it is still confronted with issues of inadequate and inconsiderate integration when particular aspects of its context tend to change over time. Moreover, in spite of its claimed social, cultural, economic, architectural and urban qualities, media architecture still seems to be considered as an embellishment, an artefact that can simply be added or switched off, or display no, or inappropriate, content.

In this chapter, we have proposed three contextual parameters to describe these context-related symptoms of media architecture: the environment in which media architecture resides, the content that is displayed, and the carrier that supports it. Based on the analysis of four real-world case studies, we have proposed a set of guidelines for the design of media architecture, aiming for 1) a sensitivity towards the social-cultural aspects in its environment, 2) a durable architectural and societal integration, and 3) early consideration and continuity in providing qualitative content. These issues should not be considered as isolated elements, but as intertwined concerns that require a systematic approach.

The analysis of context-related symptoms in this chapter has indicated the dynamic complexity of the urban environment and the need to thoroughly reflect on the context of media architecture, including its environment, carrier and content. This should ideally happen during the design process of any sizeable architectural or urban development, prior to its approval or actual construction, even when the installation of a media architecture installation was not originally planned. Accordingly, stakeholders should actively consider how context can become an intrinsic part of any media architecture design process, in order to enhance its general credibility and, hence, its survival and sustainability throughout the next generations. Additional research should lead to new evaluation methods that measure the real value and potential of media architecture, by building upon the further analysis of real-world cases in a variety of complex urban contexts. This will include analysing the typical design processes, capturing the actual perception by the general audience and determining its real impact on the urban fabric.

3

The Architectural Quality of Media Architecture

This chapter has been previously published as:

Niels Wouters et al. (2016a). „Revealing the Architectural Quality of Media Architecture“. In: *Media Architecture Biennale Conference 2016*. New York, NY, USA: ACM. DOI: 10.1145/2946803.2946808

My contributions:
In this study, I have taken the lead in laying out the research objectives and the qualitative analysis of the survey results. I also developed an online tool to conduct the survey and collect all response from participating architects. The use of Q Methodology was suggested by Koenraad Keignaert; who also conducted the quantitative analysis of survey results. The publication was authored by myself and Koenraad Keignaert, with additional support from co-authors Jonathan Huyghe and Andrew Vande Moere.

Significance and value:
The findings from our study reveal the physical, experiential and communicative qualities that architects identify in media architecture. Their way of describing quality provided us with a terminology that focuses on the relationship between architecture and media architecture. The applicability of the terminology is grounded in the real and observable opinions that architects voiced about media architecture. As a result, researchers and interaction designers gain insight into architectural qualities that support the alignment of media architecture with the architectural design rationale and experience.

Study limitations:
For this study, we invited architects to evaluate existing media architecture projects by ranking photographs and describing their personal reflection. This part of the research commenced in the early stages of the overall doctoral study. We chose to omit references to the social, economic and technical context in each of the photographs because we specifically intended to investigate the architectural quality and to gain insight into the preconceived ideas and opinions about media architecture. However, we recognise that good architecture and good media architecture must include contextual aspects. We believe that including more details about context would have revealed an understanding of the dynamic interplay between context and media architecture.

3.1 Abstract

Media architecture is becoming an increasingly affordable and ubiquitous element in our built environment. As a result, architecture gains dynamic and interactive opportunities to engage with its surroundings. However, the influence of media architecture on the experience of the built environment raises the need to avoid an architectural disconnect. In this chapter, we describe which design qualities support the architectural relevance of media architecture. We report on a Q Methodology survey among 22 architects that aimed to reveal the perceived architectural quality of 24 existing media architecture projects. Our analysis of the specific terminology illustrates how perceived architectural quality of media architecture relates to its ability to 1) coexist with physical characteristics of architecture; 2) augment space; 3) respond to contextual changes; and 4) communicate content that is relevant for the architectural situation.

3.2 Motivation

The increasing affordability of display technologies, together with an increasing pressure to communicate with large audiences in groundbreaking dynamic ways, has led to the emergence of media architecture. Here, the experience that architecture creates in its surroundings is augmented by conveying dynamic effects through a range of digital media. Manifestations of media architecture are characterised by, among others, material properties (e.g. scale, resolution), functional characteristics (e.g. technology, interactivity), and the aim to fulfil specific goals. They range from functional goals, such as providing a sense of safety [Poulsen et al., 2012], through qualitative goals, such as enlivening public space [Fortin et al., 2014b], to strategic goals, such as relaying contextually relevant information [Memarovic et al., 2010]. These new dynamic techniques thus allow for architecture to 1) rapidly change its physical appearance [Riley, 1995]; 2) continuously and dynamically influence our experience of public space [McQuire, 2006]; and 3) provide novel opportunities for people to engage and interact with each other [McCullough, 2004].

Despite the new possibilities, the proliferation of media architecture also raises concerns for responsible design action and avoiding an architectural disconnect [LaFrance, 2016]. While HCI research on media architecture commonly focuses on the qualities of interaction and technical possibilities, little is known about the architectural quality. In fact, we are still unsure why many architects are skeptical or do not embrace media architecture, or what characteristics make us perceive some media architecture as 'successful' whereas others may seem to be 'added' to architecture. The challenge remains to embed media into existing physical structures and surroundings in meaningful ways [Dalsgaard and Halskov, 2010], which thus raises the need to align the dynamic qualities of digital media with the static qualities of an architectural design rationale [Vande Moere and Wouters, 2012]. Good architecture seamlessly integrates within its temporal and socio-physical context, and is able to transform the flows, dynamics and habits of the people it hosts. However, it remains unclear how these architectural design qualities are reflected in media architecture; i.e. what qualities support 'good' media architecture that harmonises with the underlying architectural design rationale.

In order to gain insight into the architectural qualities of media architecture, we organised a survey among architects that invited them to evaluate media architecture projects and describe perceived architectural qualities. In this chapter, we explain the analysis of results

and promote the notion of considering media architecture as a form of *architecture*, rather than a form of *media*. As such, media architecture should essentially be conceived and designed to reflect (and amplify) architectural qualities, rather than be considered a part of architecture through its architectural scale and public character.

3.3 Methodology

The architectural design of space is motivated by a range of experiential, structural and functional requirements. Social, cultural, economic and aesthetic requirements balance a range of functional needs, such as providing shelter [Pevsner, 1943]. However, the terminology to describe design qualities of architecture varies across cultures, contexts and individual preferences [Stamps, 2013]. As such, there may be a consensus among architects with regards to what is considered '*best practice*' architecture (e.g. level of sustainability), but the terminology they adopt to describe architectural qualities likely differs as a result of experience, training, culture or personal preferences. Consequently, forming an understanding of design qualities involves identifying judgements that are widely shared, or conversely, investigating how weakly or strongly people agree on those judgements [Scheer and Preiser, 1994]. Q Methodology combines both qualitative and quantitative research methods and is used to examine subjective structures, such as opinions, attitudes, preferences and values [Brown, 1993]. The method has been applied in various domains, including new media [Freberg et al., 2011] and advertising [Brouwer, 1999], and is gradually finding its way in the field of HCI [O'Leary et al., 2013]. Typically, participants in Q surveys rank subjective statements according to their personal level of agreement. Factor analysis of results ultimately reveals the subjective structure of the viewpoints that exists towards the various statements.

We invited a total of 10 architectural firms in Belgium and The Netherlands to participate in our survey, from which 22 architects responded positively. All firms were selected to be professionally active for more than ten years. We did not require participating architects to have any prior experience or interest in the domain of media architecture. Participants were given access to a custom website, which guided them through all necessary steps. First, participants were invited to rank 24 still images according to perceived architectural quality. The image set contained examples of permanent and temporary media architecture, ranging from media facades and public displays to spatial media art (see Section 3.3.1: Image Set).

By default, each image was shown to participants in 576 *x* 352px resolution, and there was an option to zoom to fullscreen dimensions. First, participants conducted a "pre-sort" of images into dislike, neutral and like (see Figure 3.1). Next, images were ranked by dragging onto a forced normal distribution 2-3-4-6-4-3-2, with value judgements ranging from -3 (n=2, perceived low architectural quality), over 0 (n=6, indifference) to +3 (n=2, perceived high architectural quality) (see Figure 3.2). Forcing participants to sort images in a normal distribution is a key characteristic of the Q Methodology. It requires them to valuate their opinions carefully, and seek balance in their subjectivity. Images were shown in a random order, and contained no information about the designer, location or intent. Subsequently, participants were required to provide qualitative feedback on the highest and lowest ranked media architecture images (see Figure 3.3). Finally, they were invited to share general comments on their perception of the current and future potential of media architecture. Some participants were later invited via email to elaborate on some of their comments, if these were considered unclear or ambiguous.

Figure 3.1: Participants initially pre-sorted photographs of 24 media architecture projects into three main categories based on perceived quality: dislike, neutral and like.

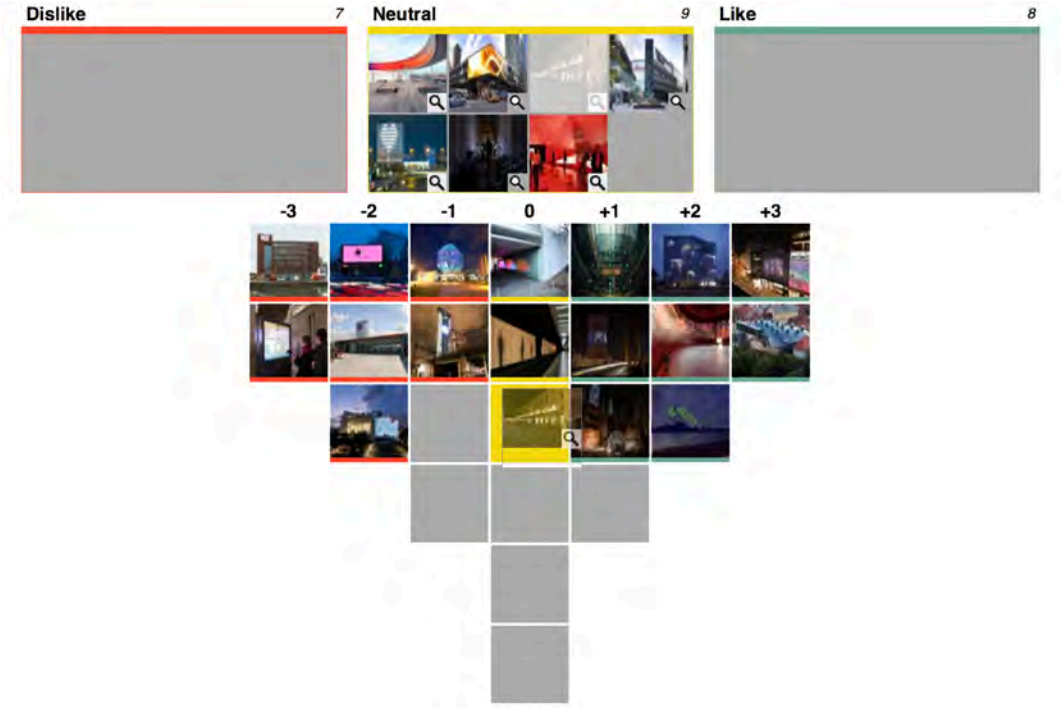


Figure 3.2: The final sort provided additional depth to pre-sorted data by forcing participants to rank projects onto a forced normal distribution with judgments ranging from -3 (low quality) to +3 (high quality).

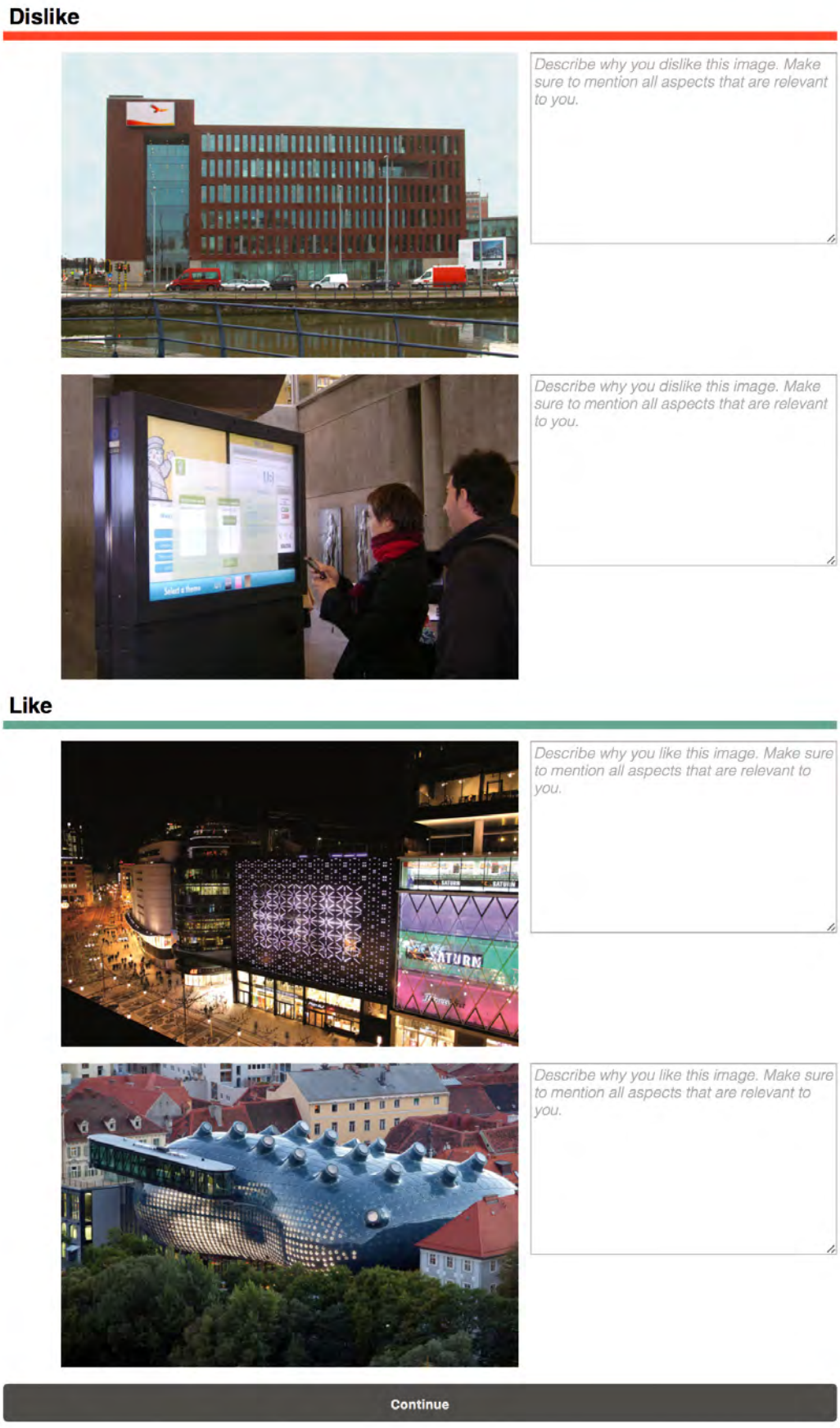


Figure 3.3: Participants were invited to detail their value judgments for the highest and lowest ranked projects.

We analysed the survey results by calculating factor scores and difference scores [Brown, 1993]. The qualitative feedback that participants provided was explored through a combination of summative content analysis and open coding [Hsieh and Shannon, 2005], to identify major themes and specific examples of architectural terminology.

3.3.1 Image Set

The media architecture projects that were included in the image set were chosen to cover a wide range of scales, content types, and technologies, and encompassed both permanent and temporary installations (see Figure 3.4 to 3.27).

3.4 Results

The centroid factor analysis of survey responses revealed the existence of two distinct discourses F1 (focus on physical integration, n=13) and F2 (focus on spatial and communicative experience, n=8), i.e. two general shared sentiments through which participants evaluated media architecture (see Table 3.1). We observed a shared consensus on 10 still images, either a perceived high architectural quality (P04, P19, P23), low architectural quality (P09, P14, P18) or indifference (P01, P12, P16, P21). The remaining 14 images significantly distinguished discourse F1 from F2. For participants loading on F1, architectural quality was perceived to be high in P02, P03, P20 and P22, and low in P06, P10 and P17. In contrast, F2 distinguishes through its high score for P05, P11, P13 and P24, and a low score for P07, P08 and P15.

Figure 3.4: P01, Zeilgalerie, Frankfurt (Germany).

Figure 3.5: P02, Galleria CenterCity, Seoul (South Korea).

Figure 3.6: P03, Kunsthaus, Graz (Austria).

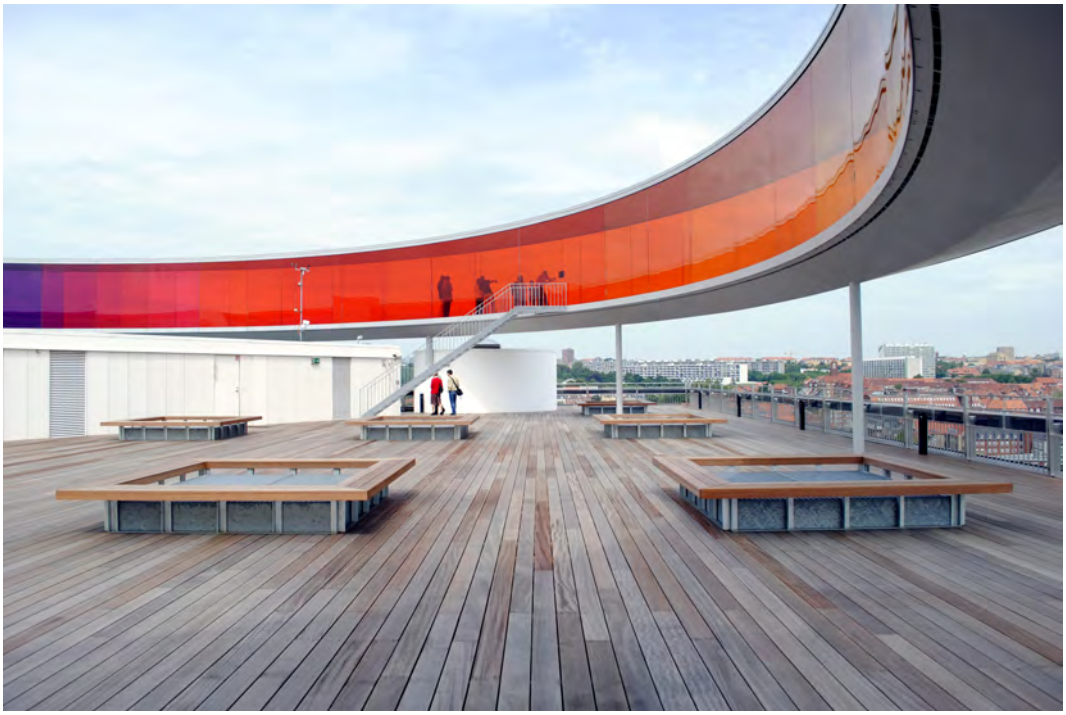


Figure 3.7: P04, Rainbow Panorama, Aarhus (Denmark).

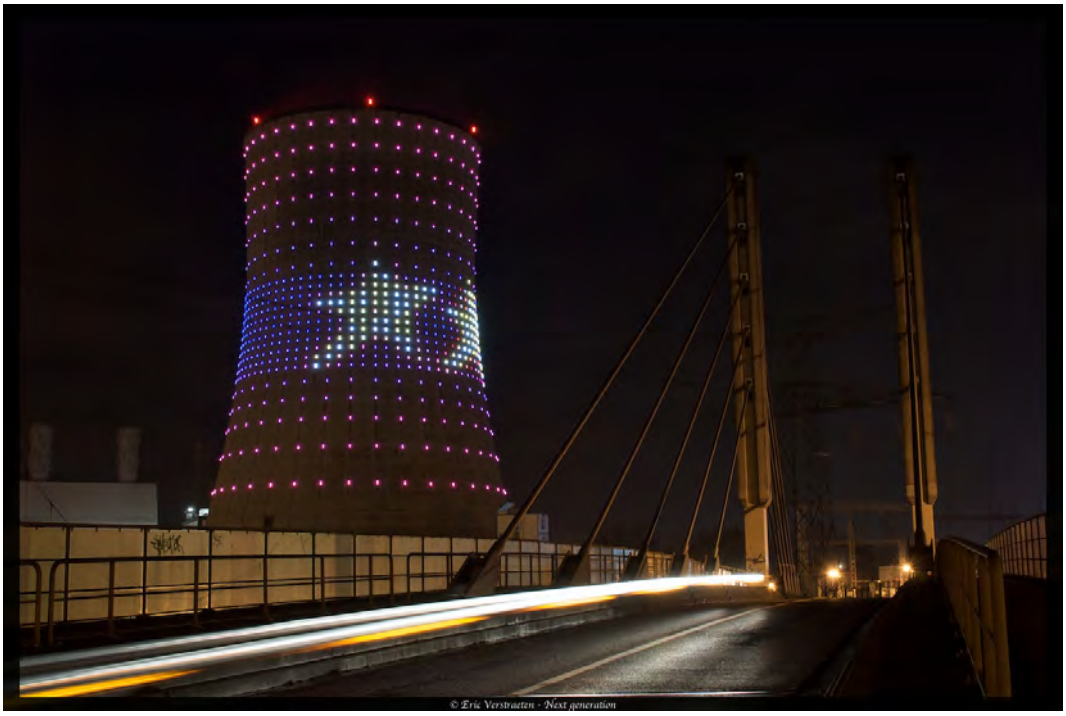


Figure 3.8: P05, Cooling Tower, Drogenbos (Belgium).

Figure 3.9: P06, National Library, Minsk (Belarus).

Figure 3.10: P07, Fire Station, Puurs (Belgium).

Figure 3.11: P08, Port Authority, New York (USA).

Figure 3.12: P09, AB InBev, Leuven (Belgium).

Figure 3.13: P10, Beeld van Den Haag, The Hague (The Netherlands).

Figure 3.14: P11, Nexus, London (United Kingdom).

Figure 3.15: P12, New World Center, Miami (USA).

Figure 3.16: P13, Place du Molard, Geneva (Switzerland).

Figure 3.17: P14, Digital Fountain, London (United Kingdom).

Figure 3.18: P15, UBI Hotspot, Oulu (Finland).

Figure 3.19: P16, Moodwall, Amsterdam (The Netherlands).

Figure 3.20: P17, Blinkenlights, Berlin (Germany).

Figure 3.21: P18, JcDecaux Gateway, London (United Kingdom).

Figure 3.22: P19, Silo 468, Helsinki (Finland).

Figure 3.23: P20, Dune 4.0, London (United Kingdom).

Figure 3.24: P21, LED Pixel Cloud, London (United Kingdom).

Figure 3.25: P22, Lotus Dome, Lille (France).

Figure 3.26: P23, Swarovski Pavlion, Basel (Switzerland).

Figure 3.27: P24, Green Cloud, Helsinki (Finland).

Table 3.1: Overview of media architecture projects shown during the survey, and the respective factor loadings.

#	Project Name	Location	F1	F2
P01	Zeilgalerie	Frankfurt, DE	1	0
P02	Galleria CenterCity	Seoul, SK	2	0
P03	Kunsthaus	Graz, AT	1	-1
P04	Rainbow Panorama	Aarhus, DK	3	2
P05	Cooling Tower	Drogenbos, BE	0	1
P06	National Library	Minsk, BY	-3	0
P07	Fire Station	Puurs, BE	-2	-3
P08	Port Authority	New York, US	0	-1
P09	AB InBev	Leuven, BE	-2	-2
P10	Beeld van Den Haag	The Hague, NL	-3	-1
P11	Nexus	London, UK	1	3
P12	New World Center	Miami, US	-1	-1
P13	Place du Molard	Geneva, CH	0	3
P14	Digital Fountain	London, UK	-1	-2
P15	UBI Hotspot	Oulu, FI	-1	-2
P16	Moodwall	Amsterdam, NL	0	1
P17	Blinkenlights	Berlin, DE	-1	0
P18	JcDecaux Gateway	London, UK	-2	-3
P19	Silo 468	Helsinki, FI	2	1
P20	Dune 4.0	London, UK	2	1
P21	LED Pixel Cloud	London, UK	0	0
P22	Lotus Dome	Lille, FR	3	0
P23	Swarovski Pavilion	Basel, CH	1	2
P24	Green Cloud	Helsinki, FI	0	2

3.5 Quality of Media Architecture

In this section, we further discuss the qualitative feedback according to the shared sentiments of discourses F1 and F2.

3.5.1 Physical Quality

For F1, the quality of media architecture is captured through its physical integration within architecture. For example, positively ranked projects such as P02 and P03 were identified to be conceived as a whole and to align with the architectural design rationale. On the other hand, we observed more critical views towards architecture that is retrofitted with display media. This is illustrated in P07, P09 and P10 where participants perceived the addition of media to existing infrastructure as '*agnostic of design rationale and context*'.

The absence of architectural quality is described through terms such as '*disproportionate*' (n=5), '*bombastic*' (n=3) and '*disconnected*' (n=2). Such terminology typically related to regular public displays, such as P07, P08, P09, P18. Displays are often referred to as '*generic*' elements (n=4), both in terms of design characteristics (e.g. '*The generic screen makes it look like an additional layer to the architecture*', P09) and placement (e.g. '*The placement could have been less generic, and [could] have embraced the formal language of the building*', P10). However, media facades were also critically analysed in terms of their integration within the architectural design rationale of a building. In particular, P06 was described as '*invalidat[ing] a volume*' (n=5) and '*mundane*' (n=1); a description that was later clarified to reflect the '*inelegant addition of lighting that destroys an otherwise interesting architecture*'. Conversely, the visual appearance of some architecture may invoke strong sentiments in itself, which can be emphasised by adding digital media (e.g. '*It's a fat bulky shape that becomes even more invasive with the added lighting*', P06).

We identified more positive attitudes when rhythm and repetition are carried through in media architecture (e.g. '*Modularity of the building served as reference for the display*', P08), or when media accentuated a formal language (e.g. '*The lights embedded in the building skin can help to demonstrate the organic architecture*', P03). Media architecture is seen as a new building block that has the potential to complement architecture (e.g. '*delivering a new materiality*', P23) and to blend in with the design rationale (e.g. '*the media IS the architecture*', P11; '*media interacts with the architecture*', P22).

Design Consideration. Media architecture is described by way of its ability to coexist with the physical characteristics of architecture in four ways: 1) how it volumetrically aligns with the architecture that supports it; 2) how its dimensionality mirrors architectural proportions; 3) how modularity extends architectural rhythm and repetitiveness; and 4) how media architecture as a new materiality blends in with the architectural expression.

3.5.2 Experiential Quality

The human experience of architecture is defined by a wide range of intangible parameters, such as distinct appreciations of spaciousness, contemporary character and harmony versus contrast [Carlson, 2000]. Architectural design involves creating spaces that invoke experiences, which is reflected in the positive evaluation of F2. From the analysis of qualitative

feedback, two perspectives onto experiential quality were identified: the atmosphere that media architecture creates, and the ability to respond to the environment.

Atmosphere. Our analysis revealed that media architecture is commonly described as a medium that creates an '*experience*' (n=10) and an '*atmosphere*' (n=6), able to '*turn non-places into places*' (e.g. P11) and even '*alter the identity of a place*'. This is not limited to the aesthetic experience of light effects (e.g. '*Small and subtle light units have a calming effect*', P20), but includes the perceptual experience of media architecture that affects both the indoor and outdoor environment (e.g. '*The effect is visible both from outside and inside. It results in compelling experiences in and around the building, which provides something for everyone*', P04).

Media architecture is able to convey '*poetic*' visual effects (n=5), to create an interesting '*scenography*' in an environment (n=3, P22), and to make a '*gesture*' towards engaging in a dialogue with its surroundings (n=2). Some of the visual effects '*inspired the imagination*' of architects (n=2). While none of the responses involved descriptions of the outdoor context, this was however considered a criterion in indoor environments (e.g. '*It's a novel kind of stained glass to amplify spatial experiences*', P22; '*Light binds the large, round space into one warm atmosphere*', P24).

Design Consideration. Media architecture is recognised to provide an opportunity to dynamically enrich architectural space in three ways: 1) establishing a mood for a theatrical presentation; 2) supporting and promoting place-making; and 3) bridging individual differences while offering collective experiences.

Responsiveness. Studies on interaction with media architecture revealed the aesthetic and engaging qualities of real-time manipulation (e.g. [Fischer and Hornecker, 2012]). Our analysis shows that perceived dynamic qualities extend to responding to the time of day (e.g. '*Facade can show particular information for daytime visitors, and support sense of safety at night*', P01) and the content that is shown (e.g. '*It might entertain people, but also provide travel information*', P11). Response to P11 and P13 captures many of the dynamic qualities of media architecture, such as '*the pavement becomes a decorative part of the urban environment at night, in contrast to its purely functional purpose during daytime*'.

In fact, media architecture is valued for its ability to resemble the functionalities that are covered by architecture or the activities that it hosts. While architecture typically only adapts to contextual requirements after decades or centuries, media architecture allows for fast, dynamic response. The latter reveals a possible use for media architecture's dynamic qualities, in changing its function and visual effect in response to quickly changing contextual requirements (e.g. ornamentation during the day, way-finding during rush hour, and safety at night).

Design Consideration. The dynamic qualities allow for media architecture to rapidly and dynamically align with the ever-changing activities, requirements and characteristics of its architectural, spatial and social context. We identify three types of dynamics: 1) real-time, such as direct interaction; 2) short-term, such as changes over the course of a day; and 3) long-term, such as changes in building occupancy or societal perception over the course of years and decades.

3.5.3 Communicative Quality

Content of media architecture ranges from informative, easy-to-read messages to abstract lighting and projection. Designers continuously seek ways to communicate in novel, creative and artistic ways, even though some content may always require unmistakable and unambiguous forms of communication (e.g. way-finding, official announcements). This vision reflects the critical stance of F2 towards the reciprocal support of media and architecture in communicating with their surroundings. For example, public screens are confirmed to be useful when unambiguous communication is sought with a broad group of users (e.g. '*It's the right means to an end*', P15). However, we learned that public displays are also considered to be a source of '*light pollution*' (n=3), '*boring*' (n=3) and '*screaming*' for attention (n=1), and their design characteristics to often be '*uninspiring*' (n=1) and '*unimaginative*' (e.g. P07, P09, P18). On the other hand, media facades are '*soft*' and '*well-considered*' (e.g. P02, P03).

Media architecture is seen to provide creative and symbolic opportunities for communicating with its surroundings; and thus potentially extend how architecture in itself engages in dialogue with its surroundings [Leach, 1997]. This is exemplified in P17, a retrofit project that is commonly referenced in literature on media architecture because of its pioneering role and interactive capabilities (e.g. [Haeusler, 2009]). Three participants ranked the project on the most negative end of the normal distribution, and validated their choice by pointing at the representation of a '*silly image*', an '*unrefined*' form of communication and the '*tacky*' feel of the media concept. The latter was clarified to refer to a contrast between the playfulness of depicting a love heart and the corporate feel of the architecture.

Design Consideration. Architecture is instrumental in influencing the perception of the message that media architecture communicates. Hence, communicating by way of media architecture requires a consideration of 1) what message is shown; 2) how the message is shown; and 3) how the interpretation of the message becomes contextualised in the physical architecture itself.

3.6 Chapter Summary

Our analysis indicates that architects recognise various qualities in media architecture, but require reciprocal support between the media and the architecture. More specifically, architects revealed that media architecture should aim to 1) amplify the overall architectural design rationale; 2) augment experiences in the surroundings; 3) enable dynamic adaptations to these surroundings; and 4) seek a balance with the message of architecture.

In this chapter, we identified many and diverse architectural qualities. Some were already known and actively exploited and researched (e.g. experience, communication, placemaking), though some were not known and have never been investigated before, such as materiality, modularity, scenography and architectural contextualisation. We believe that the further consideration of these qualities and terminology will support the integration of media architecture within the built environment and its increased adoption as an architectural building block. Media architecture will thus not solely rely on electricity and the actuation of LEDs to become a part of architecture, but exist in symbiosis, by being better aligned with the intended architectural goals and complementing the visual appearance of architecture.

While architecture is meant to exist for several decades, if not centuries, the technology that drives media architecture evolves rapidly. This raises the question what ageing of media

architecture means. However, our survey did not reveal any concerns with regards to the long-term sustainability of media architecture. As a result, the question how media architecture should respond to long-term architectural, societal and technical evolutions remains unanswered. Future research may further investigate these concerns, seek involvement from additional stakeholders such as urban planners, interaction designers, artists, advertisers and operators, and analyse cultural differences. Additionally, we believe that our image set encompasses most typologies of media architecture, but more objective ways of developing the image set to be fully representative for all stakeholders can be considered.

Part II

Media Architecture In-the-Wild

4

Study I.
OpenWindow

This chapter has been previously published as:

Niels Wouters et al. (2013). „OpenWindow: Citizen-Controlled Content on Public Displays“. In: *International Symposium on Pervasive Displays 2013*. New York, NY, USA: ACM, pp. 121–126. DOI: 10.1145/2491568.2491595

My contributions:
In this study, I have taken the lead in laying out research objectives, designing and developing technical components (*Olimex A13-OLinuXino-WiFi*, *Android*, *PHP*, *MySQL*, *WebSockets*) and analysing collected data. Plywood encasings were handmade and assembled by myself. Jonathan Huyghe has assisted me in the field setup of the study, data collection and subsequent statistical analysis. The resulting publication was authored by myself with support from Jonathan Huyghe and Andrew Vande Moere.

Significance and value:
Our study illustrates the social qualities of citizen-controlled public displays and reveals opportunities for more elaborate forms of community engagement. Based on our results, researchers and operators will be better able to assess the needs of future endeavours, such as technical possibilities (e.g. cross-posting possibilities), social opportunities (e.g. suggesting content) and the role of moderators (e.g. community control).

Study limitations:
OpenWindow was deployed in-the-wild for a total duration of three weeks. We observed disengagement emerge during the deployment, but learned about possible ways to prevent such disengagement in future endeavours. We believe that longer deployments will yield additional insights into the qualities of citizen-controlled public displays, and reveal the opportunities for community-controlled display configurations.

4.1 Abstract

In this chapter, we investigate the true ‘public’ potential of public displays by shifting the responsibility to create or control content from the traditional central authority to the citizen. To evaluate the potential value of this concept, we designed and deployed a set of small public displays behind the street-side windows of three separate houses, of which the households were each invited to provide their own content. During a three-week, in-the-wild field study, we analysed the impact of citizen-controlled public displays on both participants and community members, and we observed the relationships between the public display and the neighbourhood.

Our analysis shows how delegating the control over content on a public display to members of the community can influence social cohesion in the immediate environment as it offers an additional opportunity for discourse. Observations also highlight how the effectiveness of citizen-controlled public displays can be dependent on pre-existing social, cultural or linguistic issues. This experiment aims to illustrate the value of a more socially- and location-relevant integration of public displays in our urban neighbourhoods as a multifaceted yet democratic medium of public communication.

4.2 Motivation

Public space is a social environment that is open and accessible to all, a place that is specifically designed to host and share a wide range of civic activities. In recent years, the attention towards using technology to exploit the potential value of public space to spur social interaction and sustain social cohesion has been steadily increasing (e.g. [Paulos et al., 2009; Williams and Dourish, 2006]). Consequently, in many Western societies authorities have been installing public displays at densely travelled points of human convergence. Next to their obvious purpose for advertising, entertaining and communicating information, these displays have been promised to potentially stimulate social interaction in their immediate vicinity by bringing playful experiences (e.g. [Brynskov et al., 2009; Fischer and Hornecker, 2012]), by facilitating new forms of public and cultural engagement [McQuire, 2010; Struppek, 2010], or by extending traditional communication media platforms [Brignull and Rogers, 2003; Brynskov et al., 2009].

However, while a 'public' display is by definition freely perceivable, its accessibility in terms of the content it shows is mostly a well-kept secret. For the large majority of public displays existing today, citizens are unable to participate in the creation of content. Even though the obvious potential of public displays is to address 'everyone', regardless of socio-demographic background or technical proficiency, the process of creation, maintenance or supervision of content mostly resides with a single, central authority. More often than not, citizens do not even know who that authority might be, or what processes are in place to contact it. Instead, citizens often seem to take content on public displays for granted, which might be explained by a general lack of interest, or by some common agreement to what is shown. In fact, the basic question of what citizens actually wish to see on public displays has not been definitively answered. For instance, one could imagine an open and participative process in which transparent and democratic mechanisms allow citizens to control the content on public displays by making suggestions or participating in creation. More idealistically, full control and supervision over content could even be completely turned over to the public at large.

If citizens would be given this opportunity, what would they show on a public display? How would it differ from what is currently shown on public displays? What would be its impact on the community? We believe such knowledge is required to truly capture the social potential of public displays, i.e. their role in enriching social life in the communities that surround them. We argue that by shifting the content creation process from a central authority to community members themselves, public displays may become more relevant and integrated in their surroundings, as they will better reflect the local values and attitudes. More 'accessible' public displays may subsequently foster a stronger reciprocal relationship between the displays on themselves, the content that is shown and the local context that hosts the displays. This may elicit, renew or strengthen social interactions among inhabitants through dialogue, discussion or even new experiences.

As one of the first steps towards the 'ideal' of citizen-driven content creation on public displays, our first experiment has been relatively limited in scope and technological complexity. To overcome obvious censorship, privacy and security concerns, we developed a custom-made system, coined *OpenWindow*. This consisted of a small public display that was installed behind the street-side windows of three separate houses. Each house was located in a different urban neighbourhood and the resident households were invited to completely determine the textual content that was displayed. We build upon feedback that was acquired from participating households and community members to describe how a citizen-controlled public display has the potential to impact the social and cultural fabric of a neighbourhood. Finally, we propose a set of considerations for future endeavours in citizen-controlled public displays.

4.3 Background

Public displays form a novel platform for social interaction [Brignull and Rogers, 2003; Willis et al., 2010]. Previous research has highlighted their potential to alter our collective experience and use of public space. For example, analysis of large-scale interactive display installations has revealed how their spatial configuration can support the 'place-making' process [Fischer and Hornecker, 2012] and how they can provide a common platform for strangers to socialise [Peltonen et al., 2008]. At the same time, public display installations that provided an open forum for discourse have also proven to support civic engagement and general awareness of community issues (e.g. [Schroeter et al., 2012]). This has resulted in design guidelines for motivating dialogue and encouraging participation among citizens by controlling content on public displays through, for example, the use of mobile phones [Levesque et al., 2006] and social networks [Hosio et al., 2012], play [Schieck et al., 2008], or voting interfaces in public spaces [Taylor et al., 2012].

Recent experiments hinted at the potential of 'open display networks' where a single viewer can engage with a public display by administering its content based on his or her own set of preferences [Davies et al., 2012]. However, to fully exploit interaction by multiple viewers (i.e. community members) and to aid in community building, public displays should be designed for a rich diversity of situations that might occur in the environment [Satchell et al., 2008], for example through participative content creation or moderation, similar to traditional public notice areas [Alt et al., 2011]. Such deployments in work and education environments (e.g. [Huang et al., 2006; Memarovic et al., 2012a]) have enabled public displays to aid in the creation of social information spaces that support collaborative work. Deployments in social settings have indicated how delegating responsibility over multimedia content to members of a rural community has encouraged sustained interaction with public displays (e.g. [Taylor et al., 2007]).

Similarly, public displays should maximise the possibilities for interaction among and with the audience by preserving a balance between the location of deployment, the type of screen and the content that is shown [Struppek, 2010]. Public displays showing localised content have proven to engage spectators in dialogue with others [Memarovic et al., 2012b] and interaction with the display [Schroeter et al., 2012]. One of the challenges in sustaining a meaningful interaction with public displays lies exactly in the appreciation of content by the audience. For example, content that does not adhere to expectations from the intended audience may potentially contribute to an aversion towards displays, i.e. 'display blindness' [Huang et al., 2008; Müller et al., 2009a]. This may however be resolved by a more pronounced evaluation of the context that surrounds public displays, including the content that

is shown [Vande Moere and Wouters, 2012], by allowing them to sense their environment and deliver content that is adapted to the dynamic characteristics of the environment [Alt et al., 2012a; Cardoso and José, 2009], or by embedding mechanisms that allow public displays to respond to changing requirements over time [Friday et al., 2012].

4.4 Content Control Patterns

To describe the 'public' potential of public displays, we first analyse the different forms of control over content from a stakeholders' point of view, which typically are: 1) the entity that owns the display, 2) the entity that creates and/or publishes content and 3) the display audience.

Centralised Control

A central authority (e.g. local government, commercial agency) pushes content to the public display it owns. In this pattern, processes for content suggestion are rarely in place, thereby discouraging local inhabitants to voice desires or concerns. Therefore, this pattern for content control is optimal to prevent misuse (e.g. undesired content), and keeping the authorship anonymous, leading to neutral or objective content.

Citizen Control

One citizen or household controls content, hereby explicitly externalising the relationship between the content and its author(s). Opportunities to suggest content for all other citizens are implicitly (e.g. via conversations in the street) or explicitly available (e.g. via social networks). The supervision process may either be based on guidelines that are provided by the central authority that owns the display, or by personal preferences of the resident. As the supervisor is immediately identifiable, the risk for misuse is limited, yet content can be interpreted from multiple viewpoints, which might not be necessarily perceived as being objective or democratic in nature.

Community Control

The authority of content administration is democratically shared by a larger subset of a community, or individually distributed among a subset of members. The sharing of authorship increases the chance that content will be perceived as contextually relevant and may probably even spur competition, creativity and content variance. This scheme has the highest risk of potential misuse, although the authority to curate content might also be democratically shared, such as by borrowing methods from social media.

4.5 Case Study Design

We present the design and methodology of our pilot study and consecutive in-the-wild field study to capture and analyse the impact of a citizen-controlled public display.

We constructed three self-sustained public display systems, each consisting of a 24" landscape LCD monitor that resembled a typical public display, dimensioned to the scale of

(a) *OpenWindow* in open encasing **(b)** *OpenWindow* in closed encasing

Figure 4.1: All *OpenWindow* displays were protected by custom-made plywood boxes. Inside the plywood box was a 24" LCD monitor, power strip and IP-camera (a), whereas a mini-computer was attached to the outside (b).

a house (see figure 4.1a. Each display was attached to a single-board mini-computer for rendering the visual output and connecting to the wireless network of the household (see figure 4.1b). An IP-camera was installed on top of each monitor to record video fragments of the outdoor environment upon detecting any motion. A custom-made plywood box encased the installation to protect and conceal most technical parts. The display opening (50cm x 22cm) was made smaller than the traditional 16:9 aspect ratio on purpose, in order to avoid the obvious visual connotation to a traditional desktop computer monitor and hide the screen's bezels. Several custom-built software packages were installed to allow recoloural-time communication between the participant household and the display via a custom developed web interface (see figure 4.2). Our system only allowed textual messages to be published. After a new text message was submitted it was pushed in real-time to the display and a central database system along with metadata (e.g. layout). Upon successfully rendering the message on the display, a confirmation message was sent to the device from which the submission originated.

4.5.1 Pilot Study

A seven-day pilot study in a residential street in Leuven, a mid-size city in Belgium, allowed us to evaluate our first prototype installation in terms of its technical and practical feasibility (i.e. system reliability, readability, usability, deployment) and participation success (i.e. content, input methods). The working yet preliminary prototype was placed behind a ground floor street window, allowing household members to submit text messages of up to 80 characters via either an attached keyboard or a dedicated online interface. About 121 unique messages were published. Over half of these (n=71) aimed to interact with passers-by (e.g. '*Hello there, on the other side!*'), while others (n=29) were more philosophical in nature (e.g. '*A smile is the cheapest method to look fantastic*'). We categorised 21 messages to be personal, general observations or comments on the news.

We considered these preliminary results as promising, also because some passers-by voluntarily mentioned they had been reading the messages on a daily basis, and regretted that the display was removed. Based on participant feedback, we optimised the online interface and added immediate visual feedback in terms of authoring (e.g. allowing text editing), and messaging (e.g. confirming when the message was successfully rendered on the display), as well as multi-device access. We also added various styling options, such as a choice of typeface (i.e. sans serif, serif or handwritten) and high-contrast colour palette choices for text

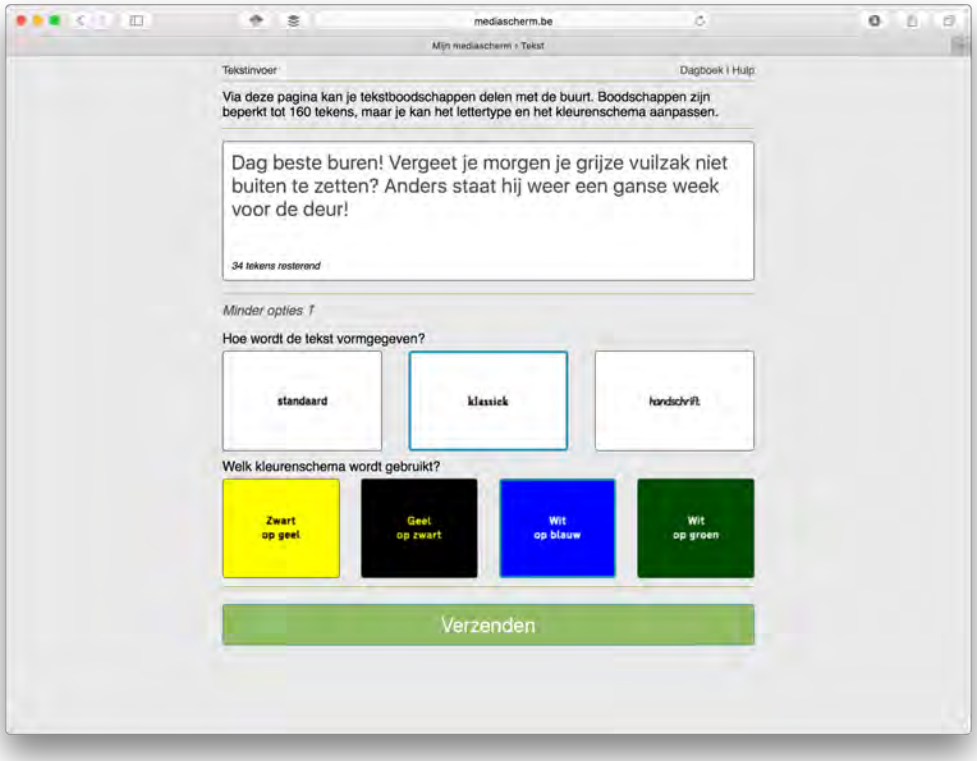


Figure 4.2: Web interface to control message content and select from several styling options, such as typeface and colour. As the form was submitted, the display contents were updated in real-time.

and background (i.e. yellow on black, black on yellow, white on blue or white on green). The textual scrolling was configured to animate upwards continuously.

4.5.2 In-the-wild Field Study

The three displays were deployed with three separate households, each living in a different neighbourhood of Antwerp, a medium-sized city in Belgium (see figure 4.3). The three neighbourhoods were carefully chosen to encompass a wide range of social, demographic and cultural differences.

As shown in Table 4.1, the neighbourhoods can be classified as: residential (A), recently gentrified (B), and containing a rich ethnic diversity (C). More specifically, in neighbourhood A, the display was installed in a recently renovated townhouse, which is separated from the sidewalk by a narrow front yard (see figure 4.4). The household was composed of a married couple (controlling the display) with two teenage daughters. In neighbourhood B, which is characterised by high-earning inhabitants, the display was placed in the shop window of a local coffee shop and controlled by the bartender (see figure 4.5). A nearby museum attracts a substantial amount of tourists. In neighbourhood C, which is characterised by a high population density, a high number of immigrants as well as a high unemployment rate, the display is deployed in a single-family house in the middle of a small, narrow dead-end street with a lot of local car traffic (see figure 4.6). The family consisted of two adults (one of whom controlled all content) and three young grandchildren.

Figure 4.3: *OpenWindow* as seen from inside a private residence.

Before Deployment. We conducted a semi-structured interview with each of the participating households to provide us with an understanding of the perceived neighbourhood characteristics, enthusiasm for the study, as well as the technical facilities that were available on-site, such as the residents' access to a personal computer or mobile device through which they would control messages, and structural access to wireless internet and power points.

During Deployment. The displays were deployed during 21 successive days. After 14 days, we distributed 400 leaflets among the residents in the immediate vicinity of the displays, which invited people to participate in an interview, in return for a small financial reward. Answers were submitted in the letterbox of the participating household.

After Deployment. All messages were analysed according to categorisation methods used in Grounded Theory [Strauss and Corbin, 1998], and mapped along a timeline to investigate any publication patterns.

The people that reacted positively on the leaflet invitation were visited at their homes for a semi-structured interview, which consisted of 30 half-open questions about the display and its contents, and 30 questions pertaining to five domains of social cohesion [Kearns and Forrest, 2000] (i.e. civic culture, social control, solidarity, social networks and place

Table 4.1: Socio-demographic characteristics of neighbourhoods.

Parameter	Neighb. A	Neighb. B	Neighb. C
Density (pop./km^2)	8,500	1,000	21,000
Employment	64%	65%	52%
Avg. yearly income (EUR)	25,000	17,300	24,500
Immigrants	19.5%	30.2%	70.4%

Figure 4.4: Public display installed behind front window of a residence in neighbourhood A.

Figure 4.5: Public display installed behind the shop front of a coffee bar in neighbourhood B.

Figure 4.6: Public display installed behind the front window of a private residence in neighbourhood C.

attachment). Answers to the latter, rated by participants on a 5-point Likert Scale, assisted in gauging a sense of community cohesion. In addition, a representative sample of five full days was selected for further video analysis. Each video clip was manually coded to reveal the number of: 1) all passers-by; 2) people who looked at, or watched, the displays; and 3) people who interrupted their walk to observe the display. Only pedestrians and cyclists were taken into account. Any other remarkable event was noted for future reference.

4.6 Results and Discussion

Our analysis revealed several findings on the influence of the deployment on the community and the participant households.

4.6.1 Impact on Community

Analysis of post-deployment interviews allowed us to compare the strength of community cohesion across the different neighbourhoods in the study (see Table 4.2; a higher percentage denotes a stronger cohesion), and its influence on the appreciation of the public display. The community cohesion was only measured after display deployment.

To reveal differences between the neighbourhoods, an ANOVA was performed, which revealed a significant difference between participants of different neighbourhoods ($F_{2,23} = 12.22, p < 0.001$). To reveal the nature of these differences, a post-hoc Tamhane T2 test (a conservative test for unequal sample sizes with assumed unequal variances) showed the sense of community cohesion to be significantly higher in A (73%) than B (43%) or C (45%) ($p = 0.029$ and $p < 0.001$, respectively). A high correlation also exists between the sense of

Table 4.2: Public display usage and neighbourhood response.

Parameter	Neighb. A	Neighb. B	Neighb. C
Published messages	64	45	59
Message analysis			
Small talk	48%	7%	44%
Entertainment	23%	44%	24%
Involvement	23%	18%	30%
Self-disclosure	4%	31%	2%
Video observations			
People walking past	72%	76%	88%
People watching	22%	21%	10%
People standing still	6%	3%	2%
Distributed leaflets	100	150	150
Interviews	15 (15%)	5 (3%)	10 (7%)
Sense of community cohesion	73%	46%	43%

community cohesion and the appreciation of the public display ($r_{23} = 0.59$, $p = 0.002$), and the desire to respond to messages ($r_{21} = 0.54$, $p = 0.008$).

Content Relevance. Many messages were directly based on events or narratives that concern the neighbourhood (e.g. '*Request to the potential buyer of number 9: Please keep the pear tree, the pears are very popular in this street!*' (A), or '*Good night, and don't forget to put your garbage bags out!*' (C)). Not surprisingly, we discovered that these sorts of messages proved to be the most memorable by passers-by. However, a relatively large part of neighbourhood C's population rarely felt addressed, because they could not understand the native language. For this part of the population, only two messages could be remembered, which were written in foreign languages with the help of neighbours from foreign origin (e.g. '*[...] Idah Saidan Wa Sanah Jadidah!*', Arabic for '*Happy Eid and happy New Year*'). This language barrier may explain the relatively high number of people that walked past yet did not look at the display in neighbourhood C, a hypothesis that was also repeated during three interviews.

Content Conversations. Some of the public displays have facilitated initiating contact between acquaintances and strangers. For instance, dialogues between customers of the coffee house (neighbourhood B) increased, often escalating into group conversations about the next message to be published (e.g. '*Fibonacci series, fill the blanks: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ...*'). A leaving customer noticed this particular message, thought it over, went back inside for a few seconds to answer the question, and subsequently left smiling. Messages with erroneous information often led to animated discussions (e.g. '*Next I will listen to the Beatles, a band from London*'). This particular mistake was revealed by a passer-by who indicated through gesturing that the content was wrong (see figure 4.7). A corrected message was agreed upon and published half an hour later: '*Haha, of course The Beatles are from Liverpool! Even though there probably is a cover band in London...*'. During a neighbourhood festivity in neighbourhood C, the participating household published 8 messages over the course of two hours that personally addressed attendees. These messages were published to show off the possibilities of the display, but also to facilitate dialogue and laughter (e.g. '*Smile! P., the photographer is here!*', see figure 4.8). Remarkably, local residents from neighbourhoods A and C regularly sent text messages to the participants to thank them for having published joyful and personal messages.

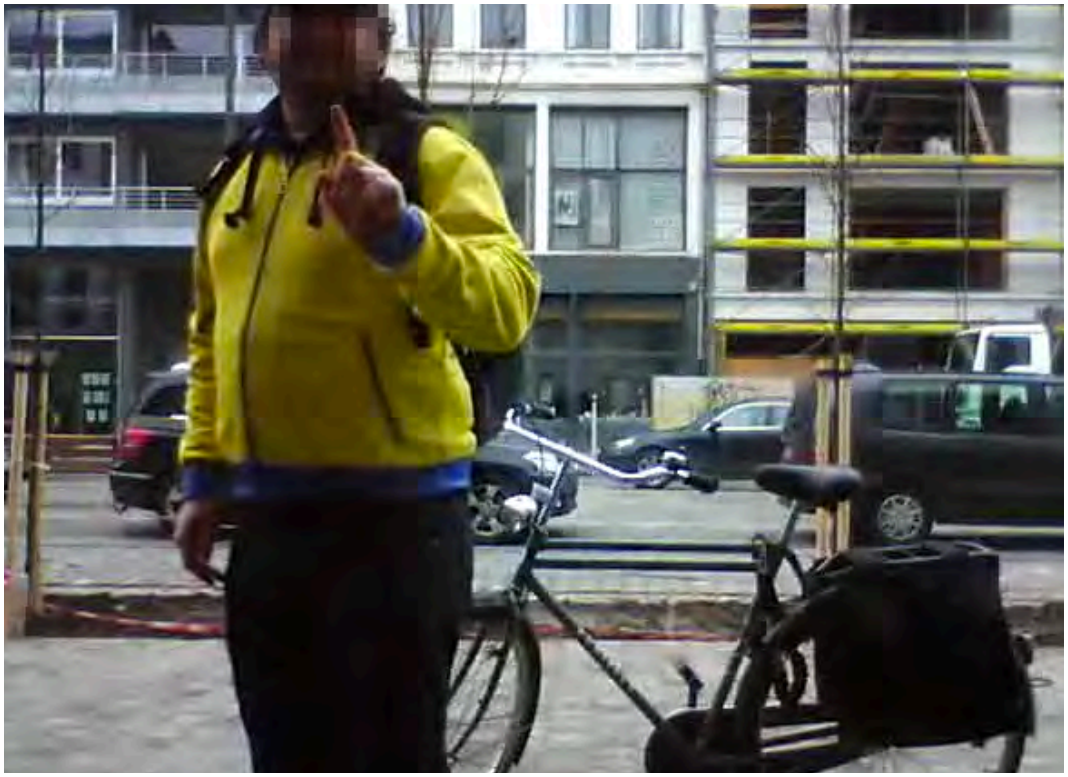


Figure 4.7: Citizen response to erroneous information shown on public display in neighbourhood B.

Social Interaction. In neighbourhoods A and C, local residents also elaborated and philosophised about messages that were published. Messages such as '*When women regularly look into the mirror, it might not be vanity, but bravery*' (A), and '*Friends are like flowers on the path of life, watching over you in good times and bad*' (C) spurred some passers-by to discuss the meaning of the message in front of the display (see figure 4.9). Discussions also occurred among family members and on online social networks. Moreover, the discussions about the messages breathed new life into neighbourhood A's existing discussion group on Facebook as the neighbour across the street of the display voluntarily committed herself to duplicate published messages online. Her primary motivation was to allow neighbours from adjacent streets to know what was published, and to get involved in discussions without necessarily having to make physical detours. This also resulted in the suggestion to start talking groups in the neighbourhood for reflecting on such aphorisms and sayings.

We observed that the profound and sustained conversations that formed in neighbourhood A, contrast with the predominantly short-lived conversations in neighbourhood B. Most of the customers of the coffee shop were tourists, who mostly noticed the display once, and then only in a transitory state. This prevented passers-by to form a relation with the display. Our results thus indicate that the existence of a pre-existing social fabric seems to correlate with the perception and acceptance of a public display, as well as the profoundness of response it elicits among community members.

Annoyances and Disagreements. During one interview, a resident in neighbourhood A pointed out that she felt wronged by not having a message published on the display for the occasion of her daughter's birthday, despite such messages being published for others (e.g. '*Happy birthday S., have a great day!*'). In neighbourhood A, three interviewees also indicated they had wanted to participate in providing content, but regretted not being

Figure 4.8: Citizen response in front of public display during local festivities in neighbourhood C.

contacted. The underlying frustration seemed to be existing frictions between groups of inhabitants from various streets in the neighbourhood, despite a seemingly high sense of community cohesion: '*Why do these people have the chance to participate, and we do not?*', as expressed by two interviewees.

Security Participants were invited to publish messages through a personal web page, which was deliberately not secured by any authentication mechanism. An intermediate interview in neighbourhood B revealed that some nearby residents had attempted to gain access to the message publication interface, but had failed and abandoned their attempts. The participants considered this to be an implicit request to take part in message creation. Unfortunately, we were unable to interview the 'hackers' and learn more about their underlying motivations.

Design Consideration. Overall, we can observe that a citizen-controlled public display – by providing a situated platform for sharing thoughts and concerns – has the potential to strengthen the social cohesion within a neighbourhood, at least on the scale of a street and in particular in a situation where a high – yet latent – sense of community already exists. However, there are obvious concerns in keeping access to such a public platform truly 'open', as some messages may be interpreted as neglecting the views, opinions, beliefs or desires from other community members. Here, the choice and social position of the controlling citizen might be deterministic in its success, as sub-communities might pre-exist, and/or approaching the controlling citizen is not perceived as obvious, or without any social risk.

Figure 4.9: Citizens discussing messages shown on public display in neighbourhood A.

4.6.2 Experiences of Participants

A total of 168 messages were published, which we categorized according to a coding scheme with four distinct categories (see Table 4.2): small talk (i.e. about the weather, current events or wishes to people, e.g. '*See? The sun is already peeking through the clouds!*' (A)), entertainment (i.e. to inspire people by making them think or laugh, e.g. '*Did you know hot water freezes faster than cold water?*' (B)), community involvement (i.e. to actively interact with passers-by and involve them in the community, e.g. '*Don't forget there is a Christmas drink tonight, starting at 7 PM*' (C)) and self-disclosure (i.e. revealing what happens inside or expressing personal opinions, e.g. '*Tonight I'll be eating pasta with tomato sauce and pancetta. Winner!*' (B)).

Creativity. Our deployment did not instruct participants what content to publish, nor did it request to be creative. However, all participants experimented with the system: in neighbourhood A, messages were published after the first day of installation that included Kanji characters (e.g. '*Haiku is a form of Japanese poetry, [...]*'), and hard line breaks to visually separate blocks of text on the display. Participant A explained he wanted to assess the system's technical capacities. Also, some participants were actively trying to interact with onlookers, such as by explicitly encouraging responses (e.g. '*Raise your hand if you sing under the shower!*' (B) or '*Beware of the dog!*' (B)).

Posting Sustainability. Over the course of three weeks, we observed a general decrease in the frequency of message publications, which evolved from an average of 3.7 to 1.6 messages per day at the end of the intervention. This decline could be observed across all neighbourhoods and was probably caused by losing interest to keep publishing original or

meaningful messages. In neighbourhood C, interest was slightly regained during the last days of deployment as nearby citizens suggested publishing trivia.

Sharing Responsibilities. The controlling households from neighbourhoods A and C suggested that they would appreciate the control to be accomplished by a larger community, rather than by a single household or citizen. This was confirmed during interviews in neighbourhood A, where four people mentioned they were willing to create and control content. Sharing authorship was actually voluntarily initiated in neighbourhood A, where the controlling household received suggestions for messages from residents via text messages and social networks.

Features. The option to change colour scheme and typeface were not shown by default (visible only when clicking a 'more options'-button), yet were frequently selected. Participant C and six interviewees across all neighbourhoods suggested adding photos to allow for more variation, while participants A and C suggested adding emoticons, to strengthen the intensity of messages, similar to the use of facial expressions in traditional text messages. Four interviewees would have appreciated a complete overview of previously published messages, and the possibility to respond to messages via email, online discussion board or social network.

Design Consideration. Our results suggest that a more sustained engagement with citizen-controlled public displays may be enforced through a publication process that is explicitly distributed among multiple citizens (i.e. moderation process where many can suggest content, but the authority to approve or disapprove is reserved for some), or delegated through some sort of open and democratic process (i.e. alternating or regularly changing the household in charge of the display). They also reveal that households and interviewees request similar additional features, to strengthen noticeability of messages and to support further public discussion. These features include the availability of a richer variety of content types (e.g. rich text, images, emoticons), a historical view of already published messages, and the ability to cross-post messages to alternative, digital media (e.g. social media), where discussions could continue.

4.7 Chapter Summary

In this chapter, we evaluated the impact of delegating control over content on public displays to one or more members of the local community. We have shown how a more active involvement of citizens in controlling content on public displays creates several inspiring opportunities as well as potentially dangerous challenges. While our first experiment only comprises the deployment of a set of small, relatively cheap displays and was conducted in a practically uncontrolled environment in terms of physical visibility, social neighbourhood cohesion, background and motivation of the chosen participants, we believe the first findings are sufficiently promising to be potentially applied in a larger scope. We also feel encouraged to promote the notion of re-assessing the traditional process of content administration on (large) public displays, and eventually, to consider its delegation to local citizens and communities. Even more, in spite of the relatively simple means of a traditional computer screen and a keyboard, at least one of our public displays (A) triggered some unexpected, constructive neighbourhood cohesion activities that are still sustained today.

In essence, we believe that the concept of citizen-driven public displays is conceptually similar to a small-scale social media platform, as the messages closely seem to resemble those of Facebook status updates and Twitter messages: personal messages that seem to address or appeal to the interests of others in the network. The essential difference lies in the social network itself: whereas a virtual social network is determined by one's possibility to choose friends according to personal preferences, the network of our physical reality is chosen 'for' us (because of the people that live or work nearby).

As such, successful and sustained message creation is more complex and layered, balancing the values and preferences of many who might not 'network' or relate to each other. In addition, while some messages can be well meant to evoke dialogue, discussion or laughter, their understanding may be compromised because of pre-existing social, cultural or linguistic issues of the people that read them. However, we believe that many of the observed negative impacts, including the feelings of being 'excluded' in terms of control and supervision or the obvious decline in actual use of the system over time, could potentially be negated by a process of shared control, in which multiple local residents either share responsibilities and distribute the content administration tasks among themselves, or each become a sole supervisor through a rotation system. In addition, at least one 'hacking' attempt has confirmed the importance of securing access to publicly accessible systems.

5

Study II.
StreetTalk

This chapter has been previously published as:

Niels Wouters et al. (2014). „StreetTalk: Participative Design of Situated Public Displays for Urban Neighborhood Interaction". In: *Nordic Conference on Human-Computer Interaction 2014*. New York, NY, USA: ACM, pp. 747–756. DOI: 10.1145/2639189.2641211

My contributions:
In this study, I have taken the lead in laying out the research objectives, the conceptual and technical design, digital fabrication and development of the situated public displays, as well as data analysis. Encasings for all public displays were custom fabricated through laser cutting and 3D printing. Electronic circuitry was developed with off-the-shelf *Arduino* components and *UDOO* micro-computers, allowing for programming in *C/C++* and *Android*. Visual front-ends were made for participating households through a combination of *PHP*, *MySQL*, *MongoDB* and *WebSockets* for real-time communication with the displays. Jonathan Huyghe has assisted me in the on-site deployment of the situated public displays, qualitative data collection through interviews with participants and neighbours, and the statistical analysis of quantitative data. The publication was authored primarily by myself, with further support from Jonathan Huyghe and Andrew Vande Moere.

Other publications related to this study:
Niels Wouters et al. (2015). „Investigating the Role of Situated Public Displays and Hyperlocal Content on Place-Making". In: *Interaction Design & Architecture(s) - IxD&A Journal* 25.Summer 2015, pp. 60–72

Significance and value:
Our study builds upon initial findings from *OpenWindow* (Chapter 4) with regards to content and community interaction, and provides new insights to integrate media architecture within the social fabric through functionality, design characteristics and content. For operators and designers, this study highlights the importance of hyperlocal content onto public displays as a means to gain contextual relevance. For architects and designers, this study raises awareness of the broad design space of media architecture, to align with the surrounding architectural social fabric. For communities and community organisations, this study reveals opportunities for self-funded and community-driven public display deployments.

Study limitations:
We have gained insight into the potential of engaging households in designing media architecture. Our efforts concentrated on participation from single households, but we recognise the potential for engaging the wider community in such endeavours, particularly in light of the public character of media architecture. Here, the design of media architecture will need to balance the opinions and expectations of more varied stakeholders, rather than relying on the shared sentiments of members from a single households.

Figure 5.1: *StreetTalk* consisted of three public displays that were designed through participation with households. *Readl* (photo) was attached to the facade of one household's private residence as a novel means of communicating with their neighbours.

5.1 Abstract

As modern information communication technologies are increasingly integrated in our public environment, challenges arise to render them locally relevant and meaningful. In this chapter, we describe the design and evaluation of *StreetTalk*, a set of situated public displays attached to house facades that were specifically designed to facilitate communication and interaction between households and their local neighbourhood.

We report on the participatory design process that resulted in a range of neighbourhood communication concepts that reached beyond the traditional screen-based notion of public displays. Accordingly, three unique displays were deployed and critically evaluated during an eight-week in-the-wild field study, which aimed to describe the potential usefulness of making public displays more situated, such as by taking into account the individual preferences of households in terms of design and functionality, by exploring alternative means of public communication, and by facilitating content creation by lay households.

5.2 Motivation

The field of *urban informatics* focuses on the potential of ubiquitous computing within the semi-public realms of our cities, such as streets, squares, pubs, shops or buses [Greenfield and Shepard, 2007; Kindberg et al., 2007]. While most commercial initiatives in the context of *smart cities* focus on improving efficiency and productivity of activities in the city by provisioning and integrating locative services, there is a recent understanding that contemporary urban life consists of a much wider range of emotions and experiences that should be ad-

dressed by technological advances [Paulos and Beckmann, 2006], such as the augmentation of social cohesion and local interactions [**Foth:2009uf**; Satchell et al., 2008].

The shared, opportunistic and situated characteristics of public displays seem ideal to tackle such challenges, in particular as technological advancement has made the necessary screen and networking capabilities increasingly accessible and affordable [Memarovic et al., 2011]. Yet still much is unknown in regards to the social and societal integration of public displays within the fabric of the city or a neighbourhood [Vande Moere and Wouters, 2012]. For instance, how would local residents envision the functionalities and design characteristics of a public display? What would be the impact of deploying public displays in a residential neighbourhood, rather than a major point of human convergence, and how does it contribute to local concerns and qualities? As a result, we believe that the design of more socially and locally situated public displays would benefit from bottom-up, qualitative input from local inhabitants who actually have to closely coexist with this communication medium.

This research took up these challenges by questioning several prototypical and canonical characteristics of a public display, in terms of: a) its physical screen-based shape and form; b) its generalised, communal and austere content; and c) its lack of user involvement in terms of its design, location or content. In order to entice sufficient enthusiasm and open-ended reflection on these issues, we exploited the playful and openly interpretive qualities of ludic design [Gaver, 2002]. Our study reveals latent communication needs and expectations within urban neighbourhoods, and provides new ideas towards alternative forms, functionalities and integration of situated public displays. We believe this knowledge is required to better understand the still largely untapped potential of public displays in supporting and engaging the urban and social fabric they are located in, so that their further proliferation in our built environment will not suffer from the visual blindness and emotional disconnection that we know from current forms of public advertising.

5.3 Background

Previous research has recognised the advantage of deploying technological artefacts in the urban environment to mediate the interaction with the city and its citizens [Wenger et al., 2009], such as to facilitate public deliberation [Hu et al., 2012], promote collective behaviour [Kuikkaniemi et al., 2011] or extend the visibility of social civic issues [Schroeter, 2012].

5.3.1 Public Displays as a Platform for Interaction

Public displays have become commonplace in the cityscape of today, as they are particularly appreciated for their ability to present inhabitants, commuters and visitors with dynamic content in the context of advertising, entertainment or communal information (e.g. [Struppek, 2010]). However, in order to motivate sustained interaction, public displays must raise curiosity while engaging imagination and fostering collaboration [Müller et al., 2010], such as by offering playful experiences [Fischer and Hornecker, 2012], increasing the awareness on socially relevant topics [Parra et al., 2014; Valkanova et al., 2013], or enabling citizens to create content themselves [Wouters et al., 2013].

Recent studies have demonstrated the opportunity for public displays to augment social interaction in urban neighbourhoods, ranging from the integration of a single small display

[Chatham and Mueller, 2013], over media facades [Fortin et al., 2014a], to a distributed network of interventions across several neighbourhoods [Laureyssens et al., 2014]. The resulting design guidelines highlight the positive influence of embedding playful and imaginative values, and providing possibilities for people to contribute to the content that is shown. In spite of their apparent success, the optimal and sustainable integration of public displays within the urban fabric still poses several challenges [North et al., 2013], including their spatial configuration [Fischer and Hornecker, 2012], the creation of suitable content [Dalsgaard and Halskov, 2010], or facilitating individual sense-making towards displays [Brynskov et al., 2009]. Within this context, it is still an open question how public displays can adapt beyond the traditional, rectangular, screen-based format [Dalsgaard and Halskov, 2010].

5.3.2 Designing Technological Artefacts with Citizens

Informing the design of technological artefacts with cultural values and personal needs from citizens has already been investigated in the context of the home (e.g. [Blythe and Monk, 2002; Dunne, 1999]). The domestic environment is recognised to include rich meaning and nuances [Bell et al., 2003], hosting activities that are not always clearly utilitarian. Therefore, the design of domestic technologies can benefit from ludic values [Gaver et al., 2004], such as to promote reflection or interpretation, or to allow unpredictable usages to emerge (e.g. [Sengers and Gaver, 2006; Vogiazou et al., 2007]).

Urban environments present a rich environment for understanding the inherent challenges of information communication technologies in the public realm [Carroll and Rosson, 2013], such as avoiding digital exclusion and meeting individual needs. The potential of involving citizens in the development of public displays has been demonstrated (e.g. [Jones et al., 2008; Taylor and Cheverst, 2009]) but, to the best of our knowledge, opportunities still exist to open up the design space of public displays and motivate citizens to design these themselves. Such an open approach may empower individual citizens to become proactive in their involvement with the city and neighbourhood [Paulos et al., 2009].

5.4 Design Process

In order to facilitate the creation of novel urban technological interfaces with the active participation from households, we have developed *LocaLudo* [Huyghe et al., 2014]. A card-based design game was chosen as the most appropriate format as previous research has highlighted the value of games to serve as a catalyst for participation [Brandt and Messeter, 2004], and card-based workshops have proven to be successful conduits to generate ideas and design new concepts (e.g. Ideation Decks [Lucero and Arrasvuori, 2010], Inspiration Card Workshops [Halskov and Dalsgaard, 2006]).

In *LocaLudo*, several households were invited to develop alternative forms of public displays that could be attached to their house facades for communicating with their neighbourhood. In order to inform the design space with meaningful inspiration, the households were encouraged to reflect on their perception of the neighbourhood (e.g. qualities, concerns) and how technological means could mediate between their everyday life and the neighbourhood in a physically, socially and culturally considerate way.

Figure 5.2: *Localudo* game with participant household; game board with cards and pawns in foreground. Participants individually collect responses to questions, which are later used for developing imaginary display concepts.

5.4.1 Home Visits

We undertook *LocaLudo* game sessions with 10 individual households living in 6 distinct neighbourhoods in and around Antwerp, a medium-sized city in Belgium. On average 3.5 household members joined each game session, with ages ranging from 6 to 65 years old. These households had voluntarily indicated their willingness to participate, after being approached during local summer festivities in their street. All *LocaLudo* game sessions were conducted at each of the participants' private residences, with assistance from one or two researchers (see figure 5.2).

The custom gameplay was inspired by *Game of the Goose*, a classic European game that allowed easy customisation according to our specific participatory needs. It consisted of a physical game board with tiles that participants traversed in chronological order. A collection of questions formed the heart of the game, which was presented as stacks of cards that asked participants to reflect on: 1) their neighbourhood (e.g. '*What characterises your neighbour's house?*'); 2) local social interactions (e.g. '*How would you welcome new neighbours?*'); and 3) the household itself (e.g. '*What is commonly discussed during family dinners?*'). As a participant's pawn entered a colour-coded tile, a random card had to be drawn from the respective question stack. The according participant was then asked to answer the question printed on the card by sketching, writing down individual keywords, or noting a more descriptive sentence (similar to *Instant Card Workshops* [Beck et al., 2008]). In order to add excitement, surprise tiles introduced a gameplay action (e.g. '*Go back two tiles*'). Researchers observed and recorded all relevant insights, which were analysed later to create a unique profile of each household.

At specific intervals, the gameplay was halted to collaboratively develop imaginary concepts for novel kinds of displays that facilitated diverse forms of interaction with the neighbourhood. Next to the answers that had been collected up to that point in the game, additional sources of inspiration included technologies (e.g. lamp, motor) and architectural elements (e.g. front door, mailbox), which were randomly drawn from a stack. These inspirations encouraged participants to think beyond existing technologies or locations, similar to how ludic interfaces stimulate exploration and reflection [Gaver, 2002]. Participants were required to use at least one source of inspiration in the development of each concept, which were summarised in an '*if... then...*' structure, such as '*[if] neighbour Albert passes by the house talking loudly, [then] his movements are followed by a light attached to the outside wall*'.

5.4.2 Results and Discussion

In total, 38 concepts were developed during 10 *LocaLudo* workshop sessions. While some of the resulting concepts were deemed infeasible in terms of technical or financial effort, they still offered a valuable perspective on how households perceived their neighbourhood, and how they wished to communicate with it. All resulting concepts were analysed according to the categorisation methods used in Grounded Theory [Strauss and Corbin, 1998], which allowed us to distinguish four important themes:

- **Social concepts** aim to create new opportunities for social contact with neighbours, such as highlighting specific skills (e.g. by way of projections) to start conversations or share expertise with others.

- **Informative concepts** enable announcements among neighbours in abstract (e.g. light) or concrete forms (e.g. text message), such as coloured light in the doorbell to symbolise the mood of the residents.

- **Critical concepts** formulate an answer to local concerns, such as a kinetic system that launched water balloons to speeding car drivers.

- **Pragmatic concepts** aim to provide functional solutions to practical problems encountered in the street, such as an ambient light to share private parking spaces with neighbours.

We observed that local issues, qualities and concerns often coincided across neighbourhoods (e.g. nuisance of speeding cars, absence of available parking space, the need for more local activities). Nevertheless, the resulting concepts differed between households both in their technical and structural nature, making them unique and personally meaningful to the household that designed them. Moreover, the playful gaming aspect created an open and creative atmosphere that motivated collaboration between different household members. For instance, a teenage daughter accusing her mother to often gossip in front of the house imagined a lighting system that enabled other neighbours to follow or join the conversation.

5.4.3 Concept Selection

After this ideation phase, we selected three design concepts to further develop into a suitable public display, in collaboration with the households that developed them (i.e. KD, BS and BB, see table 5.1). This final selection was determined by: a) differing technological means to communicate with the neighbourhood (e.g. light, audio and text); b) technical feasibil-

Table 5.1: Details on participating household compositions.

Household	Adults	Children	Participants
KD	2 Late 40's	3 Teens	2 Adults, 3 Children
BS	2 Early 50's	3 Teens	1 Adult, 2 Children
BB	2 Late 30's	2 Preteens	2 Adults, 1 Child

ity; and c) the opportunity for an intriguing architectural integration. By coincidence, the three participating households were located in the same residential street, which was characterised by a broad sidewalk and a lack of front yards, causing house facades to directly demarcate the sidewalk. Notably, this particular spatial layout facilitated more spontaneous interactions by passers-by, who could approach the house facades without feeling restrained or having to enter private property. The economic, demographic and cultural characteristics of this street approximate the citywide average (e.g. 72 % employment vs. 65 % citywide, 2011; 14 % immigrants vs. 20 % citywide, 2014).

5.5 Implementation

The collaboration process involved several returned visits to each household, email communication and phone calls, in order to iteratively fine-tune each concept according to wishes and concerns. Based on sketches that visualized the design ideas, aspects such as the look and feel of public displays, their functional possibilities, and integration with other elements of the facade were discussed. Ultimately, all households collectively agreed upon an overarching material and colour scheme.

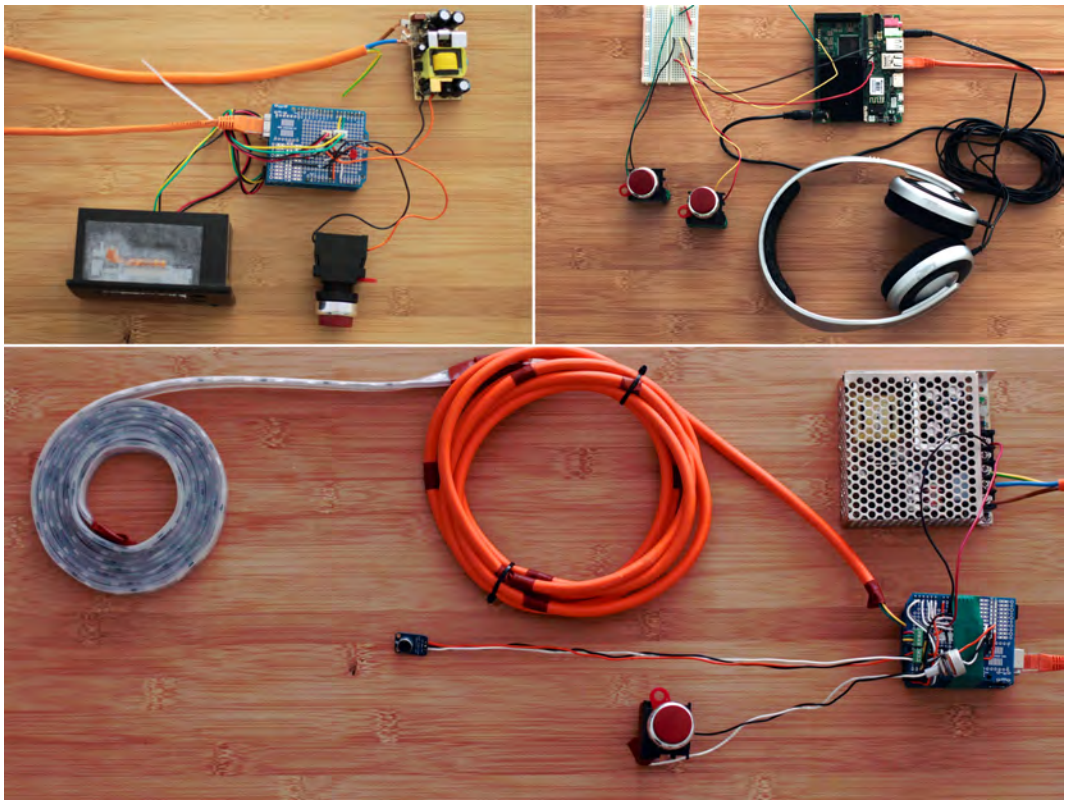


Figure 5.3: Close-up of technical infrastructure for the public displays. Top left: *Readl*, Top right: *Listen*, Bottom: *Shush*.

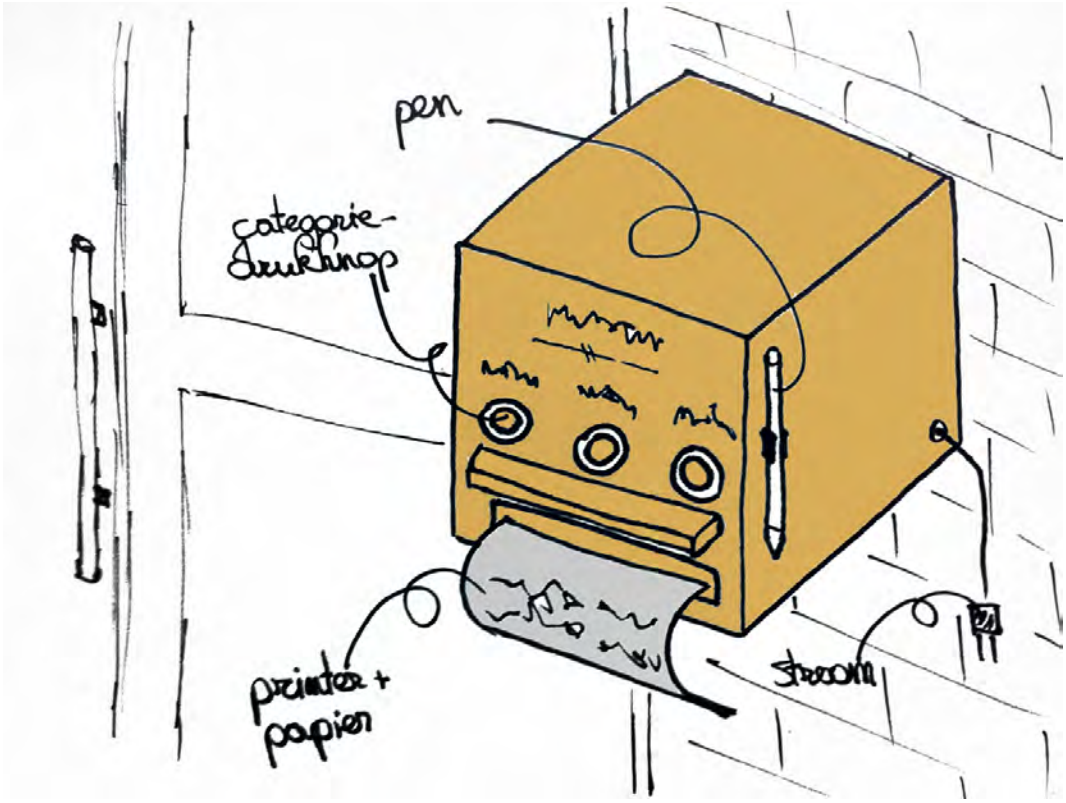


Figure 5.4: *Readl* consisted of a thermal printer that delivered one random printed message at the push of a button. Neighbours could reply by writing a response on the printed note, and depositing it in the family's mailbox.

5.5.1 Technical Design

All displays were custom-built with off-the-shelf hardware components (i.e. *Arduino* and *UDOO*) and designed to be robust and maintenance-free over a long period (see figure 5.3). Connectivity was provided via *Power over Ethernet* injectors, with receivers as close as possible to each individual display (i.e. basement, entrance hall). Industry-grade red mushroom pushbuttons were integrated to allow passers-by to interact. The firmware was thoroughly tested before deployment, especially in order to cope with multiple successive button presses. No particular measures were taken to avoid vandalism or theft. All displays were attached to the outside of the house facades, and encased in laser-cut plywood boxes. To withstand outdoor conditions, they were assembled with watertight glue. To contrast with the bright red facade colour, the encasings were spray-painted in a dark gray tint. Both power and data cables were routed along the exterior of facades, to further highlight their respective domestic ownership. Each participant household had access to a private webpage that presented real-time information for their display, and allowed them to configure the device to some extent. These webpages were served from an external webserver and developed in *HTML5* and *JavaScript*; *PHP* was used for server-side scripting. All data, including interaction with pushbuttons integrated in the public displays, was stored in an offsite *MongoDB* database.

5.5.2 Household KD: *Readl*

The concepts of the KD household focused on written communication with neighbours (e.g. addressing loitering youth with joyful messages, or revealing hidden talents of neighbours

Figure 5.5: *Readl* with integrated house number. Engraved message reads, '*Push for news*'.

on a neighbourhood public screen), as this household already acted as the administrators of a local weblog. This aspect also made them recognise communication means with neighbours that could otherwise not be reached (e.g. elderly people without internet access).

Project. Building upon their experience as weblog administrators, we designed *Readl*; a printer attached to the house as a tangible metaphor for written communication (see figure 5.4). Household members were allowed to create messages via the private webpage, including free text and questions with response options. Outside, passers-by were confronted with the custom public display attached next to the front door, displaying an engraved message saying, '*Push for news*'.

This unit contained a thermal printer, button, power adapter and microcontroller (see figure 5.5) that printed one of the most recently stored messages, along with its metadata (e.g. subject, time of publication). By default, recipients were given the possibility to reply or comment, by way of a dedicated area of whitespace on the printed piece of paper, which could then be 'posted' in the household's mailbox. Except for creating messages, the household was asked to occasionally replace rolls of thermal paper.

5.5.3 Household BS: *Listen*

The shared interest of the BS household in music, also exemplified by their enormous personal CD collection, proved to be essential in symbolizing their external identity. Their design concepts contained references to more abstract forms of interaction among neighbours, such as networked displays deployed by multiple households for sharing news and facts, or an integrated audio system to help people relax as they arrive home after work.

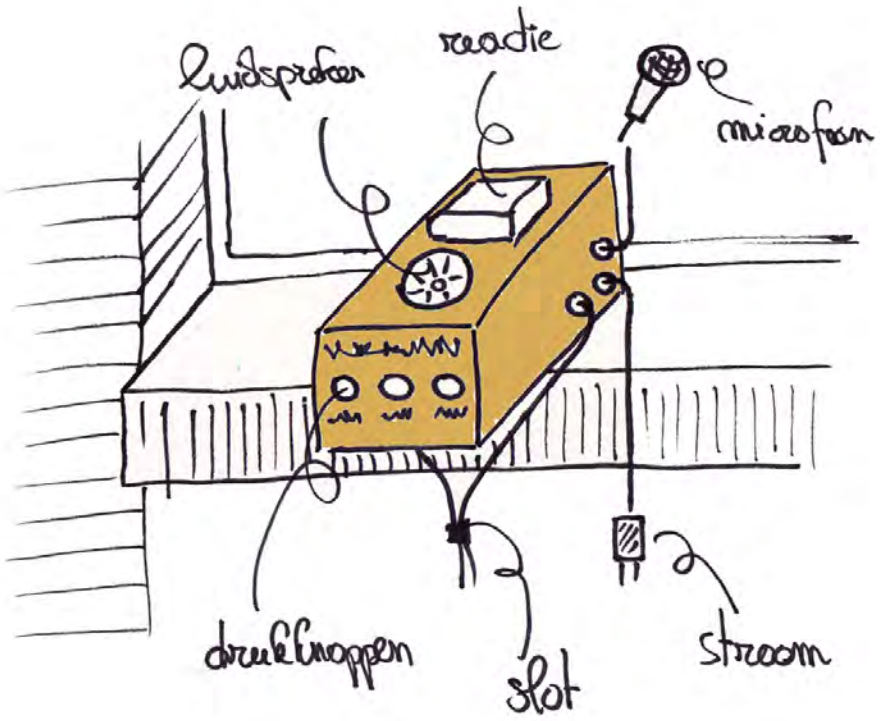


Figure 5.6: *Listen* consisted of a headphone, attached to a mini-computer and two pushbuttons. Passers-by could select to listen to either happy or sad messages.

Project. Their music interests led to *Listen*, an audio interface between household and neighbourhood (see figure 5.6). Household members were able to record audio fragments via the private webpage, and indicate a positive or negative emotion. Passers-by on the sidewalk were confronted with a control unit that contained two pushbuttons, a message saying, '*We have something to say*' and two emoticons in the shape of a smiley and a frown to indicate button functionality. A headphone was visible underneath the display (see figure 5.7). As such, neighbours were invited to put on the headphone and select the type of message to listen to. *Listen* was attached to the mailbox, as it was considered the most personal element of communication on a house facade. It also offered a poetic connotation of privately listening in to what happens inside the household.

5.5.4 Household BB: *Shush*

This household was particularly interested in the concept of ambient and dynamic lighting as a way of public communication. During *LocaLudo*, this resulted in ideas to illuminate the pavement tiles in response to people passing by, or to integrate neon lighting in the curb to make motorists visually aware of their speed.

Project. Household members specifically mentioned that street noise occasionally disturbed their daughter's sleeping pattern at night. This provided a design basis for *Shush*, i.e. a lighting element that represents ambient sound levels (see figure 5.8). It consisted of a 2-meter long RGB LED strip, attached to the windowsill of the daughter's bedroom on the first floor. A control unit was attached next to the front door (see figure 5.9), containing a pushbutton, power adapter, electret microphone and microcontroller. Upon measuring low sound levels, LEDs in the middle of the strip were coloured green, smoothly evolving to

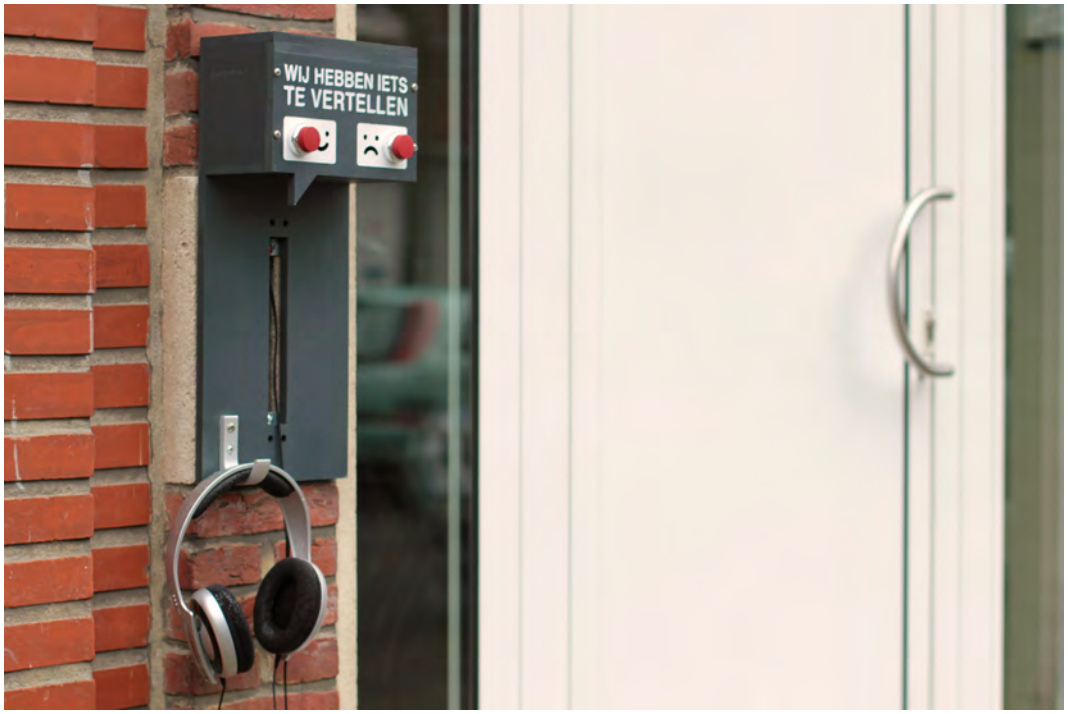


Figure 5.7: *Listen* with headphone, attached to the mailbox of residence BS. Engraving reads, '*We have something to say*'.

bright red LEDs on the strip's ends at higher measurements. When a predefined maximum measurement was reached, the LEDs pulsated. The push button invited passers-by to register their enjoyment of silence, which resulted in a gentle pulsating light effect on the LED strip in random colours. In contrast to the two other displays, the BB household was not able to manipulate any characteristics of the device, such as colours and sound sensitivity. However, the personal webpage allowed them to explore graphs of real-time, hourly, daily and weekly volume recordings.

5.6 In-the-wild Field Study

After construction, we attached the public displays to the respective house facades of the participant households. On average, each installation took about 1.5 hours by two researchers. During this time, neighbours became curious about our activities, the inner workings of displays and overall objectives. However, in order not to influence them in terms of appropriation of the displays, we refrained from informing them about the expected content and aspired impact of the displays, and as such did not illustrate any exemplary usage scenarios.

5.6.1 Evaluation Methodology

The displays were deployed for 8 consecutive weeks (i.e. 56 days), which occurred in between two major holiday periods. During this period, researchers observed each display remotely (e.g. number of daily interactions, chosen configurations) as well as onsite. Local interactions were observed at various points in time and on multiple days in order to cover a representative spectrum of days and times of day. On these occasions, particular interaction patterns were noted down and photographed, and neighbours and passers-by were briefly

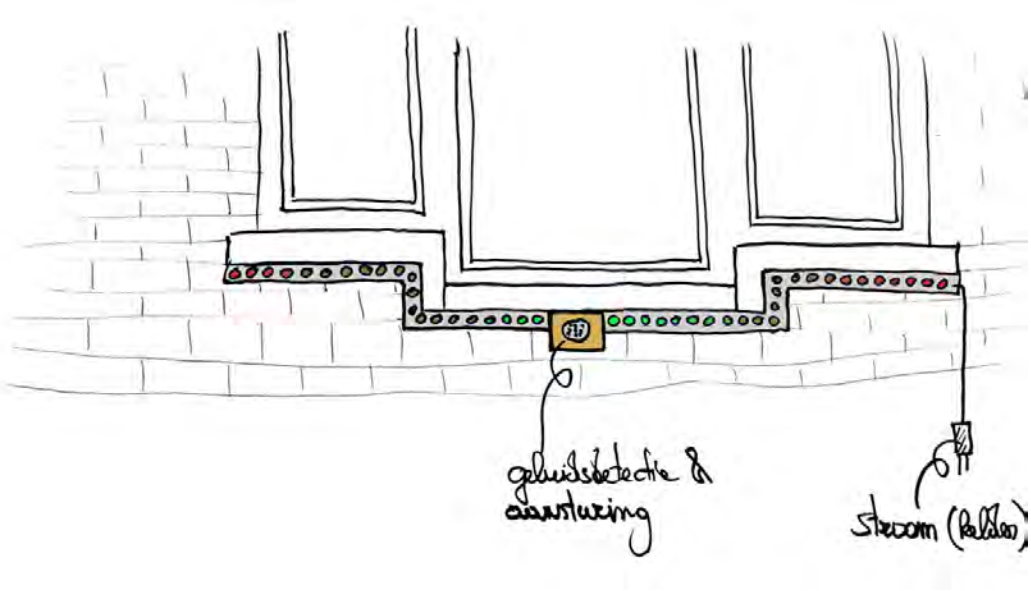


Figure 5.8: *Shush* consisted of a LED strip that depicted the ambient sound levels by way of coloured LEDs. Upon pushing a button next to the front door, a random animation was played.

asked about their motivations and opinions. Observations usually occurred for short periods of time (40 minutes) as observing the calm street felt invasive to privacy.

Four weeks after installing the displays, researchers distributed approximately 280 flyers among neighbours in the immediate vicinity of the participant households, which included invitations to take part in an interview in return for a small financial reward. After concluding the study, each participating household was rewarded to cover the additional cost of electricity.

5.6.2 Technical Observations

Despite extensive debugging, *Listen* was affected by a range of technical difficulties during Week 2. First, some Internet disconnections were traced back to the household sporadically turning off its cable modem at night. While this did not affect interactions, no logging occurred during these time periods. Second, the system audio process sporadically shut itself down without any possibility to automatically reinitialize it. As this issue could not be resolved quickly, we replaced the mini-computer with a small portable computer concealed in a cardboard box. *Shush* was involuntarily deactivated on three occasions, as the combined usage of a washing machine and tumble dryer caused a failure in its circuitry.

5.7 Results

A total of 5,493 button presses were registered, averaging 98 daily. Most interactions took place during Week 1 (see Table 5.2). On a per-hour basis, buttons were pressed mostly during rush hour (i.e. 8 to 9 AM and 3 to 5 PM), together accounting for 55% of all interactions (see figure 5.10). These time slots naturally correspond to local residents leaving to, or arriving from, work or school. Insights based on distinct button presses on the level of individual citizens have not been collected due to inherent privacy concerns. In fact,

Figure 5.9: *Shush*. Top: LEDs on second floor. Bottom: control unit next to front door. Engraving reads, '*Enjoy the silence*'.

participant households were not open to integrating cameras in the displays, which would however have allowed the analysis of more profound research questions.

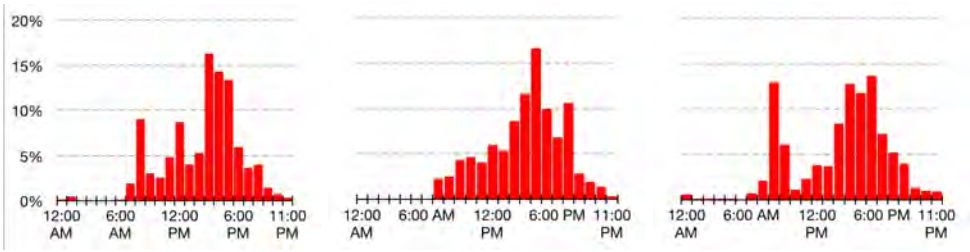


Figure 5.10: Distribution of accumulated per-hour button presses per public display (left: *Readl*, middle: *Listen*, right: *Shush*).

Soon after the study had ended and the displays had been removed, we conducted a collective semi-structured interview (180 minutes) with the three participant households. In addition, neighbours that responded positively to the interview invitation (N=10; 6 living in the same street (K), 4 living in surrounding streets (R)) were visited at their homes for a semi-structured interview (60 to 90 minutes) containing 30 half-open questions about various topics related to the displays and the neighbourhood, including their personal opinions, usage patterns and interactions with the participant households.

Readl. [KD] published a total of 114 messages, 83 of which contained free text, while 31 contained questions. Typical free text messages contained local information (n=38, e.g. '*On Friday [...] organizes a neighbourhood quiz. Come join us at [...].*'), jokes (n=14, e.g. '*What is blue and not heavy? Light blue.*'), references to time of day or year (n=13, e.g. '*Good morning, I hope you slept well. [...] In the afternoon rain is expected!*'), references to *Readl*

Table 5.2: Amount of stored messages and registered button presses per week for each of the public displays.

	Readl	**Listen**	**Shush**
Week	*Published messages*	*Recorded audio fragments*	*Logged volume exceeders*
	114	40	9,031
1	39	11	1,264
2	18	11	2,180
3	7	0	688
4	10	7	283
5	8	0	260
6	14	4	3,343
7	5	0	381
8	14	7	632
Week		*Registered button presses*	
	890	776	3,827
1	191	213	760
2	132	83	686
3	124	77	456
4	67	118	285
5	89	105	334
6	114	97	371
7	89	47	326
8	84	36	609

itself (n=11, e.g. '*Hello! These messages contain short local announcements [...].*'), or ads (n=7, e.g. '*Who wants to host a mini-concert at home on Sunday [...]? More information at [...].*'). Questions let neighbours formulate opinions about topics such as television shows, holiday destinations or sports (e.g. '*What sports do you prefer to watch during winter?*'). Out of the 890 requested prints, 143 were deposited back in the mailbox of [KD], containing written answers to questions (n=76, e.g. '*Today we will install remaining windows*', workers from nearby construction yard, replying to '*What will you do today?*') or general remarks (n=38, e.g. '*I for one know that some sweet neighbours live in this street*', in response to an activity announcement). 29 returned notes were blank.

Listen. [BS] published a total of 34 positive and 6 negative messages, which typically contained local information (n=19, e.g. '*Our street's summer party will be held on August 16. [...]*'), poetry and philosophical musings (n=9, e.g. '*Taming fishes is more difficult than swimming with fishes.*'), musical preferences (n=7, e.g. a song that sings the praises of beautiful weather), jokes (n=5, e.g. '*Good news for fans of [...]. They won! Because they haven't played.*'), or reflections on *Listen* itself (n=4, e.g. '*All good things come to an end. Next week our headphone will be taken away. [...]*'). The button for positive messages was pressed 523 times, while negative messages were requested 253 times. Some negative messages informed about the passing of neighbours and musicians, or the technical issues *Listen* was confronted with. [BS] indicated feeling less motivated to publish negative messages, as '*negative news is real news, but positive news allows for multiple interpretations*'.

Shush. Over the course of eight weeks, the preconfigured maximum volume as measured by the electret microphone was exceeded over 9,000 times. In stormy weather the microphone also responded to strong winds, which explains the large amount of maximum volume readings during Week 2 and Week 7. In contrast to *Readl* and *Listen*, observations

revealed that passers-by tended to press the button multiple times in rapid succession, to trigger new animations to commence with random colours.

5.8 Discussion

In this section, we describe how each public display was controlled by the household and used by neighbours and passers-by, which leads to design recommendations for further endeavours in the realm of situated public displays.

5.8.1 Engaging Households in the Design of Public Displays

While games are not new in collaborative design contexts (e.g. [Brandt and Messeter, 2004; Tudor et al., 1993]), we particularly exploited their playful qualities to augment the creativity of household members in imagining novel ways of community interaction, and to overcome their lay expertise. *LocaLudo* has thus provided a participative medium to capture a particular context, including its qualities, concerns and values. Even though we were forced to reinterpret some of the concepts generated during the game, neighbours still indicated that they recognised some characteristics of the participating households: '*I am sure [KD] had this printer, as he already manages our street's weblog.*' [K2]. However, for some, the external identity of households came with explicit expectations to the design of the displays that were not fulfilled: '*I was looking forward to hearing some music, as I once already enjoyed beautiful music while walking past [BS]' house. When listening however, I was disappointed to hear nothing but a joke.*' [R2]. When asked about her opinion about *Shush*, she imagined it to be designed '*in response to an annoyance, felt by the household living there*'.

Naturally, the founding relationship with the displays encouraged households to sustain the content creation in so far that even various explorations occurred. For instance, as [KD] became increasingly experienced in recording voice messages for *Listen*, he also wanted to communicate music fragments. As audio could only be recorded via the webpage, he iteratively fine-tuned the appropriate volume of his Hi-Fi system. Similarly, while *Shush* had very limited configuration options, its private configuration webpage was still used to analyse the sound measurements and to recognise potential patterns, such as the engine of a waiting school bus, passing garbage trucks, or people clapping hands.

We learned that neighbours, including residents from distant streets and several local cultural organisations, expressed interest to be actively involved in future endeavours ('*This would be great to have in [...] Street too!*' and '*Fine initiative! Feel free to come to [...]*', both in response to *Readl* messages). Some neighbours also personally identified themselves with the displays, such as [K2] who gave a visiting grandfather and friends a brief guided tour.

Design Consideration. Providing local inhabitants with opportunities to participate in the design of public displays has the potential to encourage ownership and render the displays more situated, in terms of relevancy, usefulness, sustainability and the resemblance of unique characteristics from involved local inhabitants. By taking into account the surrounding cultural, social, spatial and architectural context, the prototypical design space of public displays expands, such as by reconsidering content- and form-specific aspects.

Figure 5.11: Common examples of interaction with *Readl* (top left, group of local school children), *Listen* (bottom left, city workers) and *Shush* (right, neighbour walking past).

5.8.2 Engaging Neighbours in Interacting with Public Displays

The situated public displays provided neighbours with an additional yet easily accessible opportunity to interact with the participant households. Soon after the initial deployment, one neighbour [K1] replied on a printed message from *Readl* by asking [BS] permission to record an audio fragment of his own (announcing a fundraising sale in the near future for the illness of one of his family members). [K1] appreciated the public display communication channel due to its unobtrusive yet alternative way for campaigning. Two days later, [BS] invited [K1] over to make the recording. Occasionally, others also suggested new content, for example by leaving remarks on printed *Readl* messages: '*Tai Chi for beginners. Free trial lesson [...] in [a nearby park]*'.

Our observations as well as the returned *Readl* messages show that both occasional and repetitive interactions with the displays took place. Occasional interactions mostly involved people external to the street, as they irregularly passed by. For instance, while an environmental organisation was raising funds in the neighbourhood, one of their representatives replied, '*[...] We can taste the enjoyable atmosphere in this neighbourhood*'. However, the vast majority of interactions with the displays were repetitive. For instance, one neighbour mentioned stopping by *Readl* on his way home and printing one message daily as it '*provided an opportunity for discussions during family dinners*'. Others occasionally took their prints home and replied at a later time [K2, K3]. The abstract, real-time message of *Shush* also proved successful in promoting recurrent interaction, as exemplified by the many school children making noises in front of the display [K2, R1], or neighbours liking to walk past the house on their way to work or school louder than usual in order to observe the lights respond [BB, K2, K4, R2] (see figure 5.11).

Design Consideration. The motivations for interacting with our situated displays were diverse, ranging from predominant leisurely and opportunistic interests (e.g. simply triggering a colourful effect), to more social grounded intentions (e.g. printing news to discuss at home). Therefore, public displays have the potential to stimulate engagement if more considerations will be paid in incorporating a range of inherent interaction motivations, which commences from entertainment to more personal or strategic reasoning. The challenge then still remains on how to engage and include 'everyone' in interacting with displays, especially in terms of sustaining this engagement into potentially useful activities and habits (e.g. interacting daily when leaving for work).

5.8.3 Engaging with Hyperlocal Content on Public Displays

We noticed that bi-directional public messaging was characterised by specific qualities, of which hyperlocality seemed the most promising in the context of public displays. We have analysed hyperlocality in three ways: the specific content and relevance of messages, their 'success' in terms of engaging locals and passers-by, and their physical reach.

Message Content and Relevance. Neighbours particularly appreciated messages that took immediate inspiration on neighbourhood occurrences, such as '*[...], a primary school is looking for volunteers to help in the garden*' (*Readl*), or '*tonight X, our neighbour from number 78, passed away at 91 years of age [...]*' (*Listen*), because they were considered '*a valuable source of news*' [K1, K3] and '*it allowed me to relate to each news item; as I most likely knew who or what is was all about*' [K2]. The importance of hyperlocal relevance is exemplified by a *Listen* message that informed about the recent death of an international flamenco guitarist. Neighbours argued, '*I didn't know that person. Though, when the death of the neighbour at number 78 was announced, then I was touched*' [K3]. However, as deployment progressed, less neighbourhood-related news became available, forcing both [KD] and [BS] to publish more jokes and quizzes (e.g. '*The Tour of Flanders is on Sunday. Who is your favourite rider?*', published to *Readl*).

[KD] and [BS] mentioned they deliberately chose to only publish messages that addressed and were comprehensible to a wide audience, rather than political content or messages that related to topical societal discussions, such as the upcoming elections or reminders of civic responsibility (e.g. encouraging people to clean up after dogs). These considerations were based on their personal beliefs that societal topics only benefit from a culture of open debate that also allows deviating opinions to be voiced (which *Readl* and *Listen* insufficiently supported). In addition, the physical attachment of displays to private facades and the identifiable content they produced (e.g. the voice of a household member) made these considerations matter even more. In contrast, *Shush* allowed for more critical and reflective messages to form, as exemplified by the underlying and potentially patronising message that it symbolised. According to neighbours [K3, K4] and [BB] however, the few times that the volume threshold of *Shush* was exceeded, proved that '*[...] this neighbourhood is in fact very quiet during most parts of the day*'.

For neighbours, the explicit physical connection between the display and a private residence, amplified by brightly coloured cabling and a handmade look and feel, attributed to a sense of ownership, trust and credibility towards the messages that were conveyed: '*It's attached to a house facade and I more or less know who wrote the message, so I'm sure it will be no nonsense*' [K4].

Design Consideration. The sustained creation of appreciated and understandable content on situated public displays involves providing strategies that ensure the open-ended creation of, or readily available, news that is preferably non-controversial, while always observing its (hyper)local relevance. Situated urban displays should therefore aim to accommodate the various expectations, beliefs, values and norms that characterise the local urban environment and its inhabitants:

- Hyperlocal content on situated public displays should focus on information that local inhabitants can easily relate to, through a physical proximity (e.g. the immediate surroundings), social intimacy (e.g. concerning familiar individuals, occurrences or discussion topics) or cultural connectedness (e.g. respecting a multitude of local backgrounds and interests). This requires providing a stream of accessible, non-controversial data that is related to the neighbourhood.

- Publishing hyperlocal content raises the need to overcome issues of unfamiliarity, in particular for people that are unfamiliar with the local neighbourhood. While a method such as selecting content based on an individual's level of familiarity with the neighbourhood comes to mind, this may also encompass more elaborate techniques, such as expanding the prototypical design space of public displays to allow for open-ended interpretations to emerge, or integrating opportunities that stimulate and reward social interactions with local inhabitants.

- The objective of hyperlocal content should not be about conveying preferences or ideologies. Instead, hyperlocal content should allow people to resist or sustain its meaning on their own terms, in order to allow for the emergence of a range of shared interpretations (e.g. distinguishing between local news, official or citizen- instigated propaganda, and commercial advertising purposes).

Success of Communication.

We observed that the message contents of *Readl* and *Listen* were conceptually similar to status updates typically published on virtual social networks such as Facebook and Twitter. However, the motivational structure of both 'social' networks are inherently different: in contrast to virtual social networks that are built around personal preferences, friendships or kinships, the 'social network' surrounding a public display tends to be determined by physical proximity, i.e. members are those people that live or work close by, and thus might not be necessarily related, alike or affiliated in any significant way.

Therefore, the creation of meaningful or relevant messages is more challenging, in terms of meeting the various backgrounds and interests within this involuntary 'urban' network. A similar observation, especially the relation between a private display and the community it aims to address, is reported in the context of university campus deployments [Cheverst et al., 2005]. Here, students mentioned community-generated content to be beneficial for supporting and fostering a sense of community.

While the 'success' and popularity of typical social messages can be relatively well estimated by quantitative measures as the amount of *Likes* or *Retweets*, a similar metric is difficult to define for public displays. While eye tracking or interaction logging comes to mind, other aspects like neighbourhood commitment, awareness enlargement or public discourse fostering seem more appropriate and representative.

Design Consideration. The success of hyperlocal communication on public displays depends on the community it addresses and reaches, which is not necessarily similar to social

networks like Twitter and Facebook. Evaluating the success of hyperlocal messages involves applying metrics that are grounded in social cohesion, and can be extended with existing audience and interaction metrics. We propose further research is required to investigate these new social metrics, especially in relation to the deployment of situated public displays in urban residential neighbourhoods.

Physical Proximity. We discovered that while the displays succeeded in sparking different kinds of direct interactions, neighbours from more distant streets still refrained from engaging in a dialogue with households. They mentioned, '*I saw [members of the household] frequently, but felt uneasy to start talking about Readl as I don't know them too well*' [R2], and '*Ringing the doorbell of any of these households would definitely be a bridge too far*' [R3]. Even interacting with the display proved cumbersome, as displays were attached to houses inhabited by unfamiliar people: '*I did not print anything, because it was late and I was afraid the noise would wake the residents. I never returned*' [R2]. While qualities of the honeypot effect [Brignull and Rogers, 2003] have been shown to direct attention towards public displays, they seem mostly beneficial in busy urban spaces. We believe additional research is required to reveal how the engagement of a public neighbourhood display can reach beyond its immediate range of local inhabitants, for example by providing additional opportunities for landing effects [Müller et al., 2012], further-reaching calls-to-action or re-evaluating the hyperlocal relevance of content.

Design Consideration. Motivating citizens to engage with situated public displays regardless of their physical proximity, involves the consideration of methods to overcome issues of unfamiliarity, in particular for sporadic passers-by that have little affinity with the environment. While hyperlocality can be considered a quality in terms of augmenting the relevance and sustainability of a display, it is also an issue when communication is sought with a broader group of users.

Supporting situatedness involves more than merely providing locally relevant information, but extends to the careful consideration of a range of design characteristics relating to:

- The careful consideration of the physical location where a public display is being installed, in particular the role or meaning of that location in the surrounding environment (e.g. different connotation between the facade of private residence and street furniture that is owned and maintained by a local authority).

- Declaring or proving the authenticity of data sources, by unambiguously indicating the source (e.g. reference to city council) or by considering the physical location of the public display (e.g. facade of a community worker's residence).

- Their unobtrusive presence in the urban environment in order to not interfere with everyday life of the city. At the same time, situated public displays should provide sufficient clues for those that are interested to engage in further exploration and sense-making processes (e.g. deeper analysis of the meaning of content).

5.8.4 Engaging New Perspectives on Public Displays

By integrating ludic interfaces as a design paradigm, the situated displays have encouraged personal interpretations and reflections on the content and meaning of messages and displays. For example, some neighbours interpreted the message engraved in the control unit

of *Shush* as a question (i.e. '*Do you enjoy the silence?*') that could be answered positively by pressing the button, while others pressed the button as a voluntary commitment to encourage silence in the neighbourhood (i.e. '*Others should also enjoy the silence!*').

As a result, the displays have allowed new urban habits and behaviours to emerge, as exemplified by neighbours that interacted with the displays on a daily basis. [BB] mentioned he liked neighbours to reinterpret *Shush* as a device that playfully intertwines light and sound, instead of a device that purely aimed to patronise neighbours. In addition, one of [BB]'s daughters interpreted the random colours to be a good luck charm ('*When it's yellow, I'll be lucky.*'). As displays were peripherally present and created a pleasant environment, we notice similarities with 'calm technology' [Weiser and Brown, 1997].

Households mentioned their displays to motivate a slower paced atmosphere: people were expected to press a button, wait for a printed or audible message, or make noise in front of the house while encouraging others to join: '*The displays seemed part of a puppet theatre that we [as households] directed and performed for passers-by. Such slower pace is what constitutes a typical residential neighbourhood.*' [BB]. Also, households [BB] and [KD] indicated how they enjoyed '*watching people, standing outside and interacting with [the public display]*'. We learned from neighbours that traditional public displays unlike ours seemed more susceptible to criticism and suspicion, which was mainly attributed to their perceived dominant presence (e.g. '*You cannot ignore them*' [K4]) and tendency to communicate information with limited local relevance (e.g. '*I always forget about what they showed*' [R3], '*It always contains some form of advertising, no?*' [K3]).

Remarkably, the displays were also the subject of attention from local and national newspapers and TV stations, a phenomenon that might also illustrate some potential topics for future public display research. The attention was probably due to the 'real-world' deployment in a typical and recognisable residential neighbourhood; its open-ended, rather ludic functionality; and the creative nature of the display content that was however grounded in various urban problems that were revealed during a participatory process with common households. News reports described the physical design, but specifically featured the topicality and timeliness of such displays within the context of the changing cityscape of today, where neighbourhood cohesion and communication are perceived to be under threat.

Design Consideration. The overall positive acceptance of the situated displays could push future development to consider the qualities of alternative communication media and interaction techniques, possibly away from location-agnostic electronic screens or mobile phone applications, and towards more contextually relevant and situated interfaces that allow natural or ludic forms of interaction, especially by way of:

- Integrating elements of surprise. While a situated public display in itself can be surprising (e.g. appearing in an unexpected place), also its unexpected behaviour (e.g. concealing its core functionality) or distribution of hyperlocal content (e.g. distributing little-known local information that may even be provocative) has the potential to encourage citizens towards exploring their environment in unusual, novel and enriching ways.

- Leaving expectations about the display, its functionality and content ambiguous. While motivations for interacting with situated public displays range from leisurely to social grounded, they have the particular ability to support novel urban behaviours. For example, they have proven to be beneficial in motivating and sustaining interaction

and engagement towards useful and habitual activities. Such ambiguity positively influences public acceptance and endurance of the display and its content, as people start questioning its purpose as an individual art piece, official communication channel, or community-driven notice board. We feel encouraged to promote this notion, as all displays have been spared from vandalism, despite their fragile and self-made look and feel.

5.9 Chapter Summary

We have described the participative design and subsequent development of public displays for hyperlocal neighbourhood communication and interaction. We have demonstrated the potential of applying situated, ludic interfaces to open up the typical design space of the traditional screen-based and centrally controlled public displays. In particular, our study shows the positive and creative influence of involving households during the design of public displays, the various interactions from neighbours and neighbouring participants, the emergence of hyperlocal content, and some possible new opportunities of public display development in terms of integrating alternative or ludic communication interfaces.

Through interviews with neighbours and participating households, we have indicated the qualities and challenges of situated public displays, in terms of sustaining engagement while enticing trust (e.g. visible cabling and attachment to house in addition to identifiable content creators), warranting accessibility (e.g. big red pushbuttons that are understandable for all), arousing curiosity (e.g. impressions from neighbours and press attention) and their local situatedness (e.g. appreciation of hyperlocal content).

Based on our findings, we feel encouraged to promote the notion of situated public displays by way of active participation from local citizens. While our study has demonstrated the potential of allowing citizens to participate in the design of public displays, a challenge for future deployments remains in scaling the concept of alternative, situated public displays beyond low-resolution, temporary interventions and involvement of only a few local inhabitants. Ideally, situated displays evolve towards long-term, robust and sustainable interfaces between and among community members. Such deployments may even be self-funded by a community, or government-supported with involvement of the whole local community in terms of design, functionality and content.

6

Study III. **Encounters**

This chapter has been previously published as:

Niels Wouters et al. (2016b). „Uncovering the Honeypot Effect: How Audiences Engage with Public Interactive Systems“. In: *Conference on Designing Interactive Systems 2016*. New York, NY, USA: ACM, pp. 5–16. DOI: 10.1145/2901790.2901796

Other publications related to this study:
Sarah Webber et al. (2015). „Everybody Dance Now: Tensions between Participation and Performance in Interactive Public Installations“. In: *Australian Human-Computer Interaction Conference 2015*. New York, NY, USA: ACM, pp. 284–288. DOI: 10.1145/2838739.2838801

My contributions:
In this study, I have taken the lead in laying out the research objectives and methodology. The technical design and development of *Encounters* was taken care of by the team at the Microsoft Research Centre for Social Natural User Interfaces at the University of Melbourne, Australia. Given the large collection of qualitative and quantitative data, analysis was organised in close collaboration with three colleagues: John Downs, Mitchell Harrop and Sarah Webber. In-depth analysis of the data to uncover the honeypot effect was mostly conducted by myself. The publication was authored by myself with additional support from John Downs, Mitchell Harrop, Travis Cox, Eduardo Oliveira, Sarah Webber, Frank Vetere and Andrew Vande Moere.

Significance and value:
The Honeypot Model provides designers and researchers with a framework that allows for studying audience engagement with interactive systems as a series of contextual, spatial and social factors. Our study adds further consideration to the honeypot effect as a phenomenon that is not only dependent on watching others or being self-reinforcing in nature, but rather relying on a balance between user motivation and a range of social, ergonomic, physical, interactive, spatial and architectural aspects.

Study limitations:
The Honeypot Model adds further consideration to existing knowledge about the honeypot effect. Since our findings are solely based on *Encounters*, we may not have identified influences that may exist in other contexts. Hence, the topology we propose is not deterministic. Applying the model to other domains will reveal the existence or absence of other components, such as the influence that actors have on remote passers-by through intended guidance (e.g. texting others while interacting) or how audience members potentially stimulate engagement by way of gestures and sounds (e.g. applause).

Figure 6.1: *Encounters* was an interactive public installation that invited participants to perform various bodily gestures in order to influence sounds and visuals. Our analysis relied on the spatial arrangement of *Encounters*, including the interaction zone and the adjacent areas, in order to understand the spatial and social effects of how people transition between phases of engagement.

6.1 Abstract

In HCI, the honeypot effect describes how people interacting with a system passively stimulate passers-by to observe, approach and engage in an interaction. Previous research has revealed the successive engagement phases and zones of the honeypot effect. However, there is little insight into: 1) how people are stimulated to transition between phases; 2) what aspects drive the honeypot effect apart from watching others; and 3) what constraints affect its self-reinforcing performance. In this chapter, we discuss the honeypot effect as a spatiotemporal model of trajectories and influences. We introduce the Honeypot Model based on the analysis of observations and interaction logs from *Encounters*, a public installation that interactively translated bodily movements into a dynamic visual and sonic output. In providing a model that describes trajectories and influences of audience engagement in public interactive systems, this chapter seeks to inform researchers and designers to consider contextual, spatial and social factors that influence audience engagement.

6.2 Motivation

As interactive digital media permeates the public landscape, it becomes increasingly challenging to attract the attention of passers-by, to make them aware of the interaction opportunities, or to motivate them to engage meaningfully and sustainably. These challenges are not simply about optimising hardware or creating more attractive displays. Instead, we require a better understanding about the relationship between people, their physical surroundings and their use of technology [McCarthy, 2003].

One particular user behaviour, often observed in public contexts, is known as the *honeypot effect*. This effect is a social learning influence that causes individuals to be affected by the mere and passive presence or activities of others, regardless of any competition, reward or punishment [Zajonc, 1965]. In HCI, the honeypot effect is typically observed when passers-by move closer to a system and consider whether to engage after observing other people interacting [Brignull and Rogers, 2003]. Various aspects of the honeypot effect have been interrogated by other researchers. In particular, the specific roles and activities of users [Reeves, 2011; Tang et al., 2008], the influence of spatial configuration [Fischer and Hornecker, 2012] including the various zones of engagement [Michelis and Müller, 2011; Vogel and Balakrishnan, 2004] and the activities that take place [Memarovic et al., 2012b]. However, the aspects that drive a honeypot effect and influence the motivations to engage with an interactive system have not yet been examined in detail.

In this chapter we explore the honeypot effect by synthesising the current state of knowledge from HCI literature, and merging it with our case study observations. We propose a spatiotemporal model of the honeypot effect that consists of a series of successive engagement trajectories and contextual influences. In particular, our model also introduces a concise terminology to capture and annotate the honeypot effect in interactive systems. The critical discussion of our case study results are described as a series of design considerations that aim to reflect on how to best support manifestations of the honeypot effect in public interactive systems.

Our in-the-wild case study focused on analysing the audience engagement in *Encounters*, a public interactive installation that allowed people to influence dynamically projected visuals, sound effects and music with bodily gestures (see figure 6.1). Because of its large scale, open-ended interaction design rationale and the use of various audience facilitators, *Encounters* formed the ideal context to capture the typical characteristics of audience engagement.

6.3 Related Work

The honeypot effect was introduced to HCI to help explain the attraction to a system arising from others already engaged with it. This effect creates a 'sociable buzz' in its vicinity [Brignull and Rogers, 2003]. The honeypot effect relies on the mere presence of others and suggests engagement will result in low social embarrassment. This effect is described in studies related to public displays (e.g. [Beyer et al., 2014; Marshall et al., 2011]), media architecture (e.g. [Fischer and Hornecker, 2012; Hespanhol and Tomitsch, 2015]) and art installations (e.g. [Jorge et al., 2013; Mathew et al., 2011]).

The honeypot effect is commonly described as a natural attraction cue, such as integrating *calls-to-action* (e.g. [Müller et al., 2012]), embedding responsive visual content (e.g. [Beyer et al., 2014]) or enabling opportunities for studying peers (e.g. [Peltonen et al., 2008]).

6.3.1 Dimensions of Audience Engagement

Stimulating engagement in a public installation typically involves creating an environment that benefits social interaction (e.g. [McCarthy, 2003; Trimble et al., 2003]) and positively influences the atmosphere (e.g. [Brynskov et al., 2009; Chatham and Mueller, 2013]). Specifically, an environment that aims to motivate a honeypot effect should balance a range of

spatial, interactive and social aspects. We discuss the significance of each in relation to the honeypot effect.

Spatial. The layout of space influences the subjective experience of the environment [Hillier and Hanson, 1993], and technology has become increasingly apt in actively shaping that experience [Dourish and Bell, 2011]. Hence, an interactive installation is not simply situated in a location, but its presence in itself creates 'situations'. For instance, Urban HCI provided a concise model of how the spatial configuration around a public installation creates such situations, highlighting the role of potential interaction spaces as possessing the ideal physical characteristics to stimulate social interaction [Fischer and Hornecker, 2012]. The notion of embodied constraints describes how certain spatial configurations and physical structures invite or impede group activities around tangible, interactive systems [Hornecker and Buur, 2006]. Key design characteristics include configuring the nearby physical space to allow people to interact concurrently, allowing multiple access points to distribute control over the system, and providing interaction possibilities that adapt to peoples skills.

Interactivity. The *Audience Funnel Framework* [Michelis and Müller, 2011] describes how people tend to organically transition between various levels of interactivity while evolving towards engagement with a system. Transitions range from quickly glancing as a viewer and causing an initial response as a subtle user, to interacting as a direct user. As people transition, quantifiable conversions between phases can be recognised, which are typically low (i.e. high threshold) as people engage in an initial interaction. Building blocks have the ability to transform these initial forms of interaction into more active engagement. Hence, they are successful in increasing conversions, for example by motivating activity, triggering curiosity or stimulating collaboration with others [Müller et al., 2010]. One such building block is described in the *PACD model* [Memarovic et al., 2012b], where gradually uncovering features of a system leads to discovery and active engagement. In interactive systems, the typical aim is to motivate interaction while providing a potentially engaging experience. Notably, this design goal does not necessarily imply that the 'success' of an interactive system is proportionate to increasing the number of interactions [Brignull and Rogers, 2003]. Even the absence of any interaction from bystanders contains a potential opportunity for their interaction at a later stage [Tang et al., 2008], or for watching the activities that are performed by active participants [Meisner et al., 2007; Webber et al., 2015]. As such, besides providing active participants in a system with a pleasant experience, systems should take into account the different degrees of participation in their vicinity, while unobtrusively inviting bystanders to engage in participation [Lehn et al., 2007].

Social. Users engaging with interactive systems tend to be driven by emotional, sensual, compositional and spatiotemporal influences [Wright et al., 2003], not dissimilar to how art is impacted by the relationship between the self and the art object [Dewey, 1934]. Accordingly, user interaction in public contexts is shaped by the presence of others, including the social norms that govern the relationships between each of them. Public contexts expose a particular contrast between the roles of performers (i.e. acting in front of others) and spectators (i.e. learning from others to increase proficiency), potentially decreasing the likelihood of interaction for fear of social embarrassment [Brignull and Rogers, 2003; Reeves et al., 2005]. In fact, systems should be configured to accommodate for the physical proximity of the user [Tang et al., 2008]. As users gradually become conscious of their role, their perception of the system is shaped [Dalsgaard and Hansen, 2008]. Interactive systems aim to take people on journeys while they explore and utilise the features [Sommerer and Mignonneau,

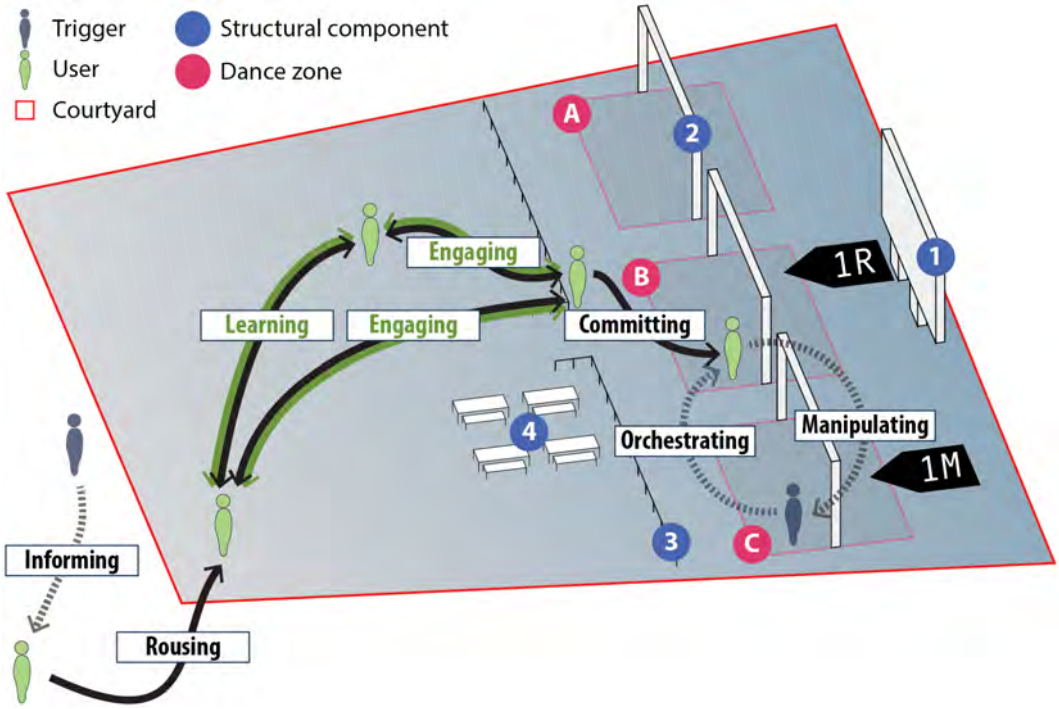


Figure 6.2: Spatial representation of *Encounters*, the dominant trajectories and influences, and the main components: LED screen (1), archways with sensors (2), dance zones (A, B, C), fence (3) and seating area (4).

1999]. These journeys, commonly referred to as *trajectories*, describe how people navigate through a predefined set of narratives that is purposively composed by the designers [Benford and Giannachi, 2008]. Whereas systems may intend that people follow *canonical trajectories*, the very nature of interactivity allows for individual and unpredictable choices, i.e. *participant trajectories*, even when performers inform and support participants [Loke and Robertson, 2010]. As such, engagement becomes a continuous dialogue between the system and the participant, between participants themselves, and between the participants and the spectators [Reeves et al., 2005].

6.4 Encounters

Our findings are based on the analysis of how people engaged with *Encounters*, a public, interactive installation that encouraged people to playfully explore a variety of dynamic visuals and soundscapes. *Encounters* was installed in a public courtyard during a summer festival in Melbourne, Australia, which ran over four evenings.

6.4.1 Technical Design

The interaction space of *Encounters* consisted of three 5x5m dance zones (see figure 6.2 and 6.3). Each zone featured a large archway that supported a dynamic lighting system, six surround sound speakers, and an overhead Microsoft Kinect sensor that continuously monitored the area beneath. The dance zones were established by delineating a physical area underneath the archways by strategically pointing ambient lighting. A single 5 x 4m LED screen was installed facing all three dance zones. Depth data from the sensors was communicated to proprietary software at a rate of 30fps. The software processed, detected

Figure 6.3: Set-up of *Encounters*, containing three large archways that hold sensors, dynamic lighting systems and surround sound speakers.

and interpreted a series of characteristics of every individual's movements in real-time, including the location in three-dimensional space, the velocity, and the distance from other nearby individuals. The system was controlled from a central work area (see figure 6.4) and continuously broadcasted appropriate reactions to a music sequencer that controlled the surround sound and lighting, and to custom software that generated the dynamic imagery on the screen.

6.4.2 Conceptual and Social Design

The overarching artistic theme of *Encounters* was inspired by the wider cosmos, reflecting in part the dark and outdoor nighttime environment it was located in. Its dynamic visual and audio design switched between six distinct styles, each of which was successively displayed for 10 minutes. The visual aesthetic styles were based on a particular artist's interpretation of the cosmos, ranging from a near-photorealistic representation (see figure 6.5, top left) to more abstract iconography (see figure 6.5, bottom left) or typography (see figure 6.5, bottom right). The dynamically composed soundscape of *Encounters* combined melodic and rhythmic elements of ambient and minimal music, which were composed to persuasively stimulate movement of people on stage. Each aesthetic style and accompanying soundtrack responded in real-time to the positions and activities of the people in the dance zones, and the physical distances between them. Each detected person was represented by a unique visual element, which was animated according to the input data, encompassing transformations such as scaling, rotating and morphing. One significant interaction was a 'supernova' that appeared as multiple persons approached within 30cm of each other, causing the corresponding elements to converge into a single visual entity. Various sound effects were overlaid on top of these soundtracks, and directly responded to a range of activities on stage, e.g. as people jumped on stage, a *whoosh*-ing sound was played.

Figure 6.4: All sensor data was continuously processed and interpreted from a central work area. Data from each depth sensor was continuously processed by several dedicated workstations.

As part of the artistic expression, three dancers stepped into the three dance zones every 30 minutes to perform a 10-minute prearranged choreography. The choreography consisted of three distinct phases, with each phase intensifying the interaction with participants. Initially the dancers performed a short solo routine (approx. 3min), during which they orbited around the people that were already present within the dance zones. During the second phase (approx. 2min), the dancers interrupted the rehearsed performance and talked directly to the people within the dance zones, as they encouraged them to form groups, for example by holding hands or bunching together. The formed group was then instructed to break apart, causing a drastic response in the visuals as the system recognised the transformation from a single, large entity to multiple, small elements. From this point on, the dancers encouraged participants to freely move around across the three dance zones, causing comet tails to appear on the LED screen that followed the movement of the participants. As participants started to improvise and engage with *Encounters* on their own terms, the last phase of the choreography (approx. 5min) consisted of dancers retreating into a solo performance, which finished with a brief ensemble dance.

6.4.3 In-the-Wild Field Study

Encounters was deployed on the same location during four separate evenings, running for a total time of 19 hours. Each performance started at 7PM and closed at night (until 11PM on three occasions, until 2AM on one occasion). Between performances, some spatial, technical, and artistic components were tweaked for optimisation.

Evaluation Methodology. Each evening, three researchers conducted a contextual inquiry by observing the engagement behaviours taking place from randomly chosen locations around *Encounters*, and by conducting semi-structured interviews with participants, dancers

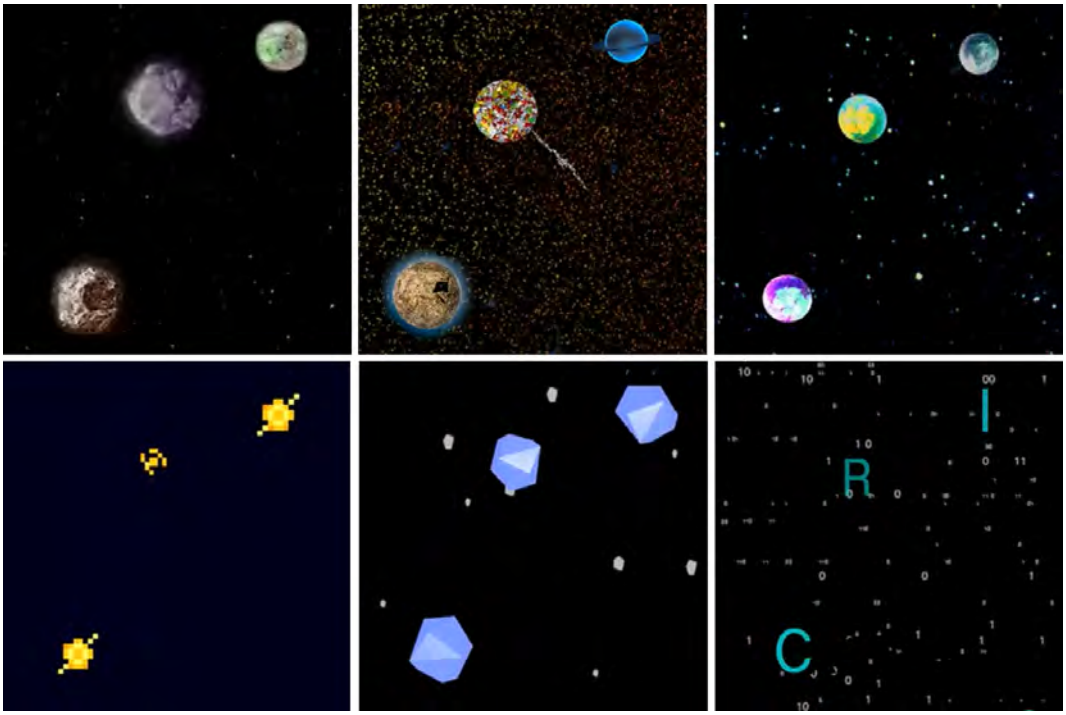


Figure 6.5: Overview of the visual aesthetics of *Encounters*, each representing identical depth sensor data.

and pitchmen. Questions aimed to uncover the trajectories between and experiences of different user roles: such as why participants felt motivated or discouraged to interact within the dance zone, how participants learnt about interactive features, and how dancers and pitchmen perceived their interaction with people. All interviews were audio recorded, and additional notes were taken on-site. In addition, all movements within the dance zones were recorded as video and depth data. The depth data was later segmented into tagged information to identify the number of people, start and end times, speed of movement, jumps, and configurations of people that were dancing over time.

Results During the four evenings, a total of 1,159 people were counted entering the performance zones, with a maximum of 629 participants during the final performance (which took place alongside a major metropolitan light festival). On average, each person spent approximately 30 seconds in the performance area. There were about 3 people in the performance area at any given time, though the middle zone (B) seemed to attract substantially more people (5 people) than any other (2 people in area A and 3 people in area C).

We conducted a total of 125 interviews (of which 80 were taken from groups of people), taking an average of 6.0 minutes each (SD = 37.4s). A team of four researchers analysed the interview notes according to categorisation methods used by Grounded Theory, including open coding and selective coding. Our analysis focused on revealing the nature of social and performative interactions, and the transitions of users as they engaged with *Encounters*. During each workshop session, groups of three to four attendees sorted the interview notes, while iteratively adjusting, debating and refining the coding scheme. This process is similar to previous studies that relied on group analysis [Carter et al., 2014]. Our approach helped in managing the sheer volume of data (i.e. 384 notes from 125 audio recordings), while allowing for new insights to emerge and previous insights to be refined. Hence, each session concluded with a plenary discussion of changes to the analysis process. The resulting

analysis yielded a taxonomy of engagement types, a chronology of how people gained an understanding of the supported functionalities and perceived goals, and a classification of the influences that people experienced. These are further explained in the following sections.

6.5 Honeypot Trajectories and Influences

The insights from the analysis were synthesised and a model consisting of user roles, trajectories, influences and triggers was created. All these aspects are integrated in the spatiotemporal Honeypot Model (see figure 6.6).

6.5.1 Triggers

The most apparent and persuasive component of the system included the audiovisual feedback. However, potential participants were also informed via various printed and online publications, accessed remotely or in the vicinity of *Encounters*, while pitchmen roaming around the surrounding streets further encouraged passers-by to participate. Finally, hired dancers demonstrated the interaction features and encouraged collaborative behaviours such as group-based dance choreographies (see figure 6.7).

Based on definitions from captology [Fogg, 2009], depending on whether they increased the intrinsic motivation or the ability of passers-by to engage with the system, we propose these components acted either as triggers, i.e. respectively sparks or facilitators, as they specifically intended to persuade users to participate. *Encounters* captured the third type of trigger, signals, in the system itself, along with its supported functionalities and technologies.

6.5.2 User Roles

Initially, people became aware of the installation's existence through one or more triggers. As people entered the courtyard, noticed the music, saw the distant dynamic lights and visuals, and observed some physical activity among the attending audience, they became vaguely aware of the potential engagement with *Encounters*. Upon approaching closer by, people entered a seating area where many paused in order to observe the interactions that others performed, and to more intensely experience the visuals, sounds and music. Within the seating area, various forms of social interaction between people took place, such as telling each other about the installations features. As people decided to enter the dance zones and their physical presence was detected by the overhead Kinect sensors, the system responded with appropriate visual and auditory feedback.

We identified two types of exploratory behaviours that emerged after people became aware of the interactivity. We coded these behaviours as interacting oneself into existence, which was characterised by people restricting themselves to a brief process of exploration. This process involved mimicking the behaviour of others and performing basic, axial movements directly underneath the sensors, such as to identify themselves on the LED screen. As soon as they felt sufficiently comfortable and empowered, movements became more diverse, often involving acts such as running around, dancing and holding hands with others. The exploratory activities within the dance zones were also influenced by the performances that took place every 30 minutes, as dancers orchestrated the audience in a collaborative choreography. Ultimately, people abandoned their engagement and left the dance zone.

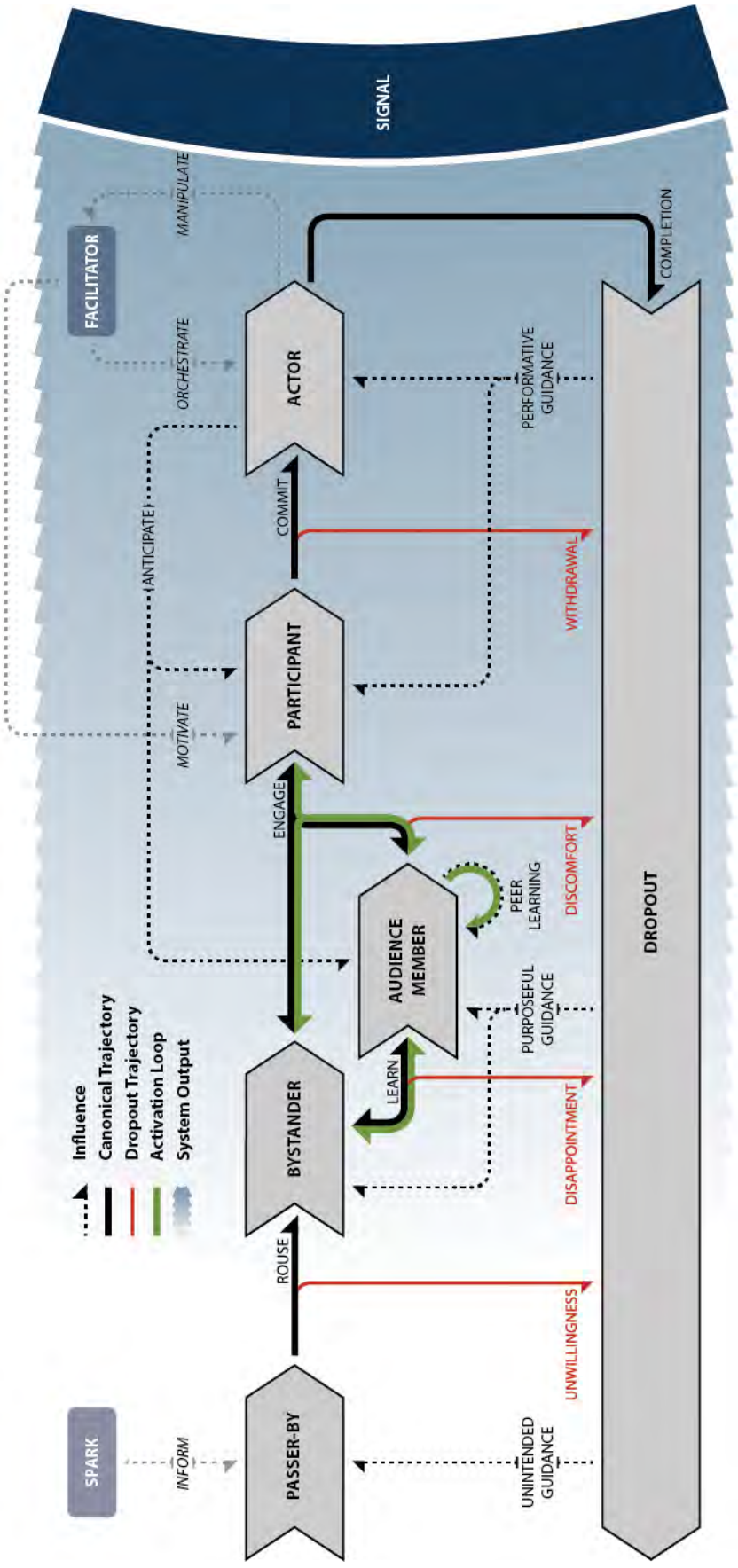


Figure 6.6: Honeypot Model containing the user roles, trajectories, influences and triggers that affect how audiences engage with interactive systems.

Figure 6.7: Dancers (identifiable by EL wire wrapped around the body) facilitated participants and actors to engage in a collaborative dance.

Based on these observations, and complementary to terminology introduced in an analytic framework for public interfaces [Reeves, 2011; Tang et al., 2008], we identify six user roles.

- A **passer-by** roams around the immediate vicinity of an interactive system (i.e. situated passer-by) or learns about its existence via triggers. As some triggers may not be situated in the vicinity of the system, we propose the notion of remote passers-by.

- A **bystander** has experienced some form of (distant) visual, sonic, tangible or spatial expression of the interactive system (i.e. system output), yet are still unaware of the system's true interactive features.

- An **audience member** is familiar with the interactivity and the social norms surrounding a system, such as by reading instructions, or observing or discussing with others.

- A **participant** exhibits subtle forms of engagement with a system, such as moving slowly in the interaction space. Even though participants actively take part in interacting, they are still discovering interactive features and building a sense of comfort, and typically lack particular signs of profound commitment or enthusiasm.

- An **actor** demonstrates some committed form of engagement. This form of engagement is most noticeable in the nature of interactions (e.g. complex behaviours, challenging or testing out the system's capabilities), the extended amount of effort or time spent while interacting, or the apparent motivation to share their experience or seek the collaboration with others.

- A **dropout** has abandoned engagement with the interactive system, for instance by purposively not engaging with the system, or by leaving the interaction zone. Notably, any user role is able to drop out for various reasons, even when no interaction with a system has yet occurred.

6.5.3 Trajectories

Within the context of our research, a trajectory describes the chronology of how people move towards and through distinct user roles. We observed canonical and participant trajectories [Benford and Giannachi, 2008] in *Encounters*, and a range of dropout trajectories. Ultimately, we introduce the activation loop as a key trajectory to motivate and sustain engagement.

- The **canonical trajectory**, as envisioned by the *Encounters* designers, aimed to smoothly transition users from passer-by to actor and eventually dropout.

- Personal desires and expectations result in a participant to creating her own **participant trajectory** when experiencing an interactive system. Here, users organically transition back and forth between user roles.

- We observed instances of people abandoning every user role. We discovered that the reasons for choosing a dropout trajectory often corresponded with the experience that people had within their last actual role, although external issues could have occurred as well (e.g. unexpected phone call). For example, audience members typically dropped out because of social reasoning (e.g. crowdedness, perceived complexity of interactions), whereas actor dropouts were mostly due to having exhausted all interactive features of the system. As such, we propose four **dropout trajectories** (highlighted in red, figure 6.6), which we articulate in section *6.6.5: Dropping Out: Transitioning Out of Engagement*.

- We noticed how the activities of participants within a dance zone served as the main 'activator' for bystanders and audience members to move closer and engage for themselves. Particularly, it created a sense of anticipation to learn more about the features and interactivity. Occasionally, participants also retreated to a role as bystander or audience member, to gain more knowledge about the interactive features, or build a stronger sense of comfort. As such, we define the **activation loop**, a self-reinforcing trajectory that is capable of reactivating the interest and motivation to join the interaction.

6.5.4 Influences

We observed how the transition between user roles was affected by various forms of social interaction with other people. These included conversing with other participants (e.g. *'I talked with someone who stood next to me. He told me I could jump to change letters*', interview #68, young adult); studying the physical behaviour of others (e.g. *'It was a little unclear in the beginning, but watching others helped to understand what was possible*', interview #54, young couple); and collaborating with actors (e.g. *'I felt sufficiently at ease to hold hands with strangers. It helped to identify myself on the screen*', interview #21, young family).

Accordingly, as users engage with an interactive system, their expectations are also shaped by the activities of others. We refer to these occurrences as influences, i.e. explicit or implicit forms of social interaction between people and that affect engagement with a system. We identified 10 distinct influences in *Encounters* that depend on transitions between user roles, and will discuss them in the next section.

6.6 Analysing Trajectories and Influences

To demonstrate the potential usefulness of the Honeypot Model in the design and evaluation of interactive systems, we further describe how particular spatial, social and interactive elements affected the success of trajectories and influences in *Encounters*. By analysing the nature of the observed trajectories and influences between user roles, we are able to reflect on their actual impact, which is then formulated as a set of design implications that aim to optimise the effectiveness of the honeypot effect in future endeavours. Figure 6.2 illustrates a graphical notation of how the main trajectories are physically situated within our case.

6.6.1 Rousing: From Passer-by to Bystander

Making activity in front of an interactive system visible beyond the interaction space itself is a potentially efficient technique to rouse initial engagement among passers-by [Reeves, 2011; Vogel and Balakrishnan, 2004]. However, the spatial configuration of *Encounters* prevented the interaction activity to be noticed from surrounding streets. Therefore, we used various sparks to inform passers-by. These included symbols painted onto road surfaces, printed signage along main roads leading to the installation, and some digital signage in the alley that provided access to the courtyard.

In addition, several clearly recognisable pitchmen mingled with passers-by. Although the pitchmen did not adhere to a strict schedule or script for approaching people, the process usually involved seeking contact, enquiring if they were having a good time, and asking if they would like to spend time at 'an interactive dance performance'. No additional details were shared about the range of supported interactions or expected behaviours in order to create a surprising experience.

The use of different sparks had a distinct effect on passers- by. The signage was most effective for passers-by that were initially unaware of the installation (e.g. '*I was walking past, noticed the signs, and just followed them*', interview #55, young couple), even though or precisely because it did not provide them with clear instructions (e.g. '*I read about Encounters in the online brochure. It didn't tell much about what could be done, and that motivated me to come and visit*', interview #11, young family). Those who already intended to visit *Encounters*, occasionally benefitted from additional information given by pitchmen: '*We wanted to see Encounters, but it was good to have the volunteers around to tell us more*' (interview #19, young couple).

Design Consideration. Making people aware often requires some form of advertising, which is dependent on the perceptual reach of the media output, its spatial configuration or persistence over time. While local signage forms an obvious choice, advertising may also involve more contextual techniques like those adopted by street performers to build up crowds, such as using the skills of dedicated pitchmen that directly address passers-by, or providing opportunities [Carlin, 2014]. Along the rousing trajectory, the ideas about a system that develop among people should not be influenced, by not revealing details on particular functionalities, elements or characteristics of the system [Tang et al., 2008]. Such open-ended and ambiguous experiences create an opportunity for people to remain comfortable as an audience member, or seek further details about a system by more readily interacting with peers and bystanders.

Figure 6.8: *Audience members* learn about the various interaction possibilities within *Encounters* by watching other people's interaction in the interaction space.

6.6.2 Learning: From Bystander to Audience Member

We discovered that the typical trajectory for audience members included some form of learning. Since no instructive guidelines on how to interact in the dance zones were shown or explained, the learning process required some conscious effort. Most audience members first aimed to become familiar with the expected interactions (e.g. '*We've been enjoying [watching] other people do it. Trying to work it out from afar*', interview #22, middle-aged couple); the social norms that existed (e.g. '*As we watched others dancing, we could decipher the intrinsic rules of the game*', interview #49, young couple); or the inner workings (e.g. '*It took us a while to learn this must be picking up people's motions in one particular area*', interview #80, father and daughter). The learning trajectory commonly involved some form of social interaction with others, particular those who had previously participated: '*The people who aren't actually interacting, are [behind the fence], interacting with each other while trying to explain it. It's got everyone talking*' (interview #22).

Audience members that had no intention to learn, commonly watched the performance purely for personal enjoyment (e.g. '*Youre just drawn to it. You can sit here and look at it*', interview #23, middle-aged couple); were discouraged by a perceived fear of social embarrassment (e.g. '*I entered a dance zone, but only for a short time. It felt more comfortable to just watch others*', interview #108, young couple); or refrained from further engaging because of social obligations (e.g. keeping an eye on personal belongings while family and friends were in a dance zone). These audience members appreciated and enjoyed a certain degree of physical and social comfort, which the space provided in the form of a seating area adjacent to the dance zones (see figure 6.8). Notably, participants who dropped out, used this particular area to relax (see Section *6.6.5: Dropping Out: Transitioning Out of Engagement*) and, in turn, became themselves approachable sources of information to teach their peers about features of the system.

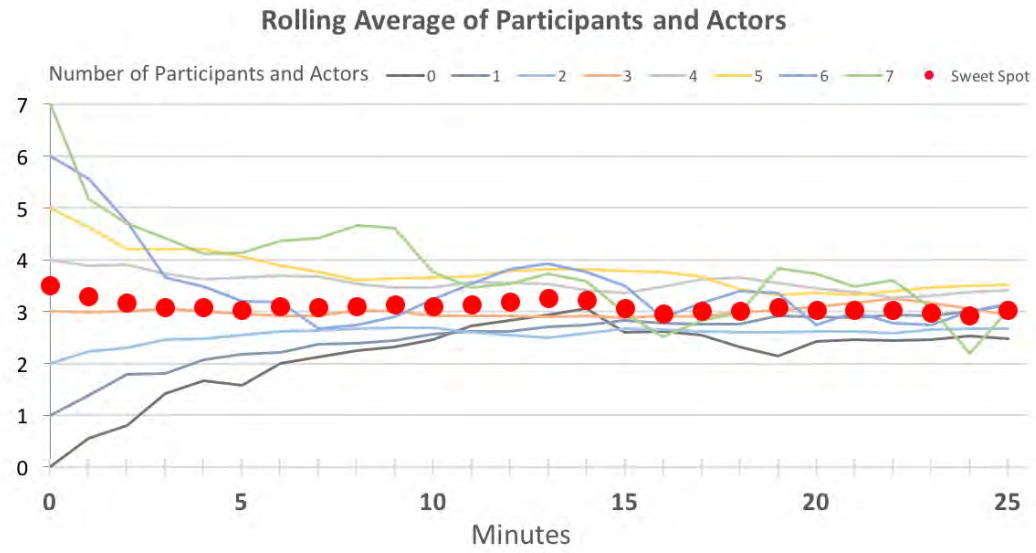


Figure 6.9: The honeypot sweet spot, i.e. the evolution of the rolling average number of participants and actors (Y axis) within any given dance zone over a 25-minute period (X axis).

Design Consideration. Learning by watching other people's behaviour in an interaction space (e.g. [O'Hara et al., 2008]) provides a context for one's own potential activities in later stages [Dourish and Bell, 2011], even when people decide to refrain from any engagement. Learning also occurs via various forms of social interaction, particularly between different user roles along the canonical trajectory. Therefore, physical environments that aim to accommodate such learning process should focus on providing a comfortable space that caters for the physical and social needs of audience members. For instance, such space should warrant a nearby and uninterrupted visibility of the interactive system [Meisner et al., 2007], while supporting stationary postures without fear for social embarrassment. Such space should also accommodate social interaction and opportunities for peer learning, for instance by stimulating approaching others, overhearing conversations or sharing experiences. Ultimately, such space should also accommodate for the absence of any interaction, such as from passive audience members. Here, a level of physical and social comfort is needed that supports spectating a performance, rather than socialising with peers.

6.6.3 Engaging: From Bystander over Audience Member to Participant

Two external factors influenced engagement in the dance zones: the number of people that simultaneously interacted, and the ambiguous meaning of unexpected events.

The Honeypot Sweet Spot. We discovered that the number of people simultaneously interacting with *Encounters* influenced the motivation of other participants. Figure 6.9 represents the rolling average of how the number of concurrent participants within the dance zones (Y-axis) affected the growth or decline of participants over a 25-minute timeframe (X-axis). The initial condition is the average number of people within a single dance zone per minute. Consequently, the diagram demonstrates that when two people are dancing, the number of participants tends to increase; whereas five participants trigger a decline over the course of 25 minutes. Our sensor data revealed that this number balances out at 3.1 partic-

ipants per dance zone (SD = 0.8). We refer to this number as the *honeypot sweet spot* (see figure 6.9, red-dotted line). We believe this phenomenon can be best explained by physical and spatial constraints: the archway's physical dimensions (5m) allows for a maximum of three people (3x approx. 1.75m) to stand next to each other, directly underneath a sensor. While there is still substantial space in front of or behind this line for people to move around, audience members might have perceived the dance zone to be fully occupied or experienced difficulties understanding the visual feedback: '*As more people entered the dance zone, we lost motivation. It got crowded, and we couldn't identify ourselves on the screen*' (interview #108, middle-aged couple).

This finding adds significance to previous findings in literature that indicate the honeypot effect is mainly unidirectional and self-reinforcing [Müller et al., 2012]. Our study shows that interactive systems are not necessarily able to accommodate a continuously increasing number of participants, but reveals a balance between user motivation and ergonomic, social, hardware and software constraints. Continuous recurring participation may not even always be desirable as, for example, the content or narrative may have reached its end, participants may have lost interest, or others may want to start interacting. As a result, participants can be expected to return to a role as audience member or bystander, and potentially even drop out of interaction.

Design Consideration. Interactive systems should consider how to tackle the *honeypot sweet spot*, i.e. the optimal number of participants that simultaneously interact. It requires taking into account a range of spatial and social constraints, such as the visibility of available interaction space, the hardware and software constraints that limit how many people effectively can be sensed or receive feedback in parallel, or simply the ergonomic dimensions of the system. To manage the *sweet spot* dropouts, specific trajectories could be designed to encourage people to seamlessly travel back and forth between the roles of participant, audience member and bystander depending on the number of simultaneous participants, or provide opportunities for dropouts to share their experiences with audience members. The aim is not to recommit dropouts into interaction, but rather stimulate knowledge transfer.

Unexpected Events.

Encounters experienced an unexpected power outage during one dance performance, causing all audio and visual systems to shut down even though the dancers continued with their choreography. In follow-up interviews, participants remarked that they felt unsure if the power outage was deliberate and staged: '*It made us focus more on the dance performance, and we were less distracted by the visuals and the sounds*' (interview #49, young couple). This ambiguity therefore unintentionally made people wonder about how the installation was designed, and whether the temporary lack of interactivity was a legitimate part of the overall experience. It also illustrates how counterintuitively a lack of interactivity is still able to refocus the attention to the behaviour that the interactivity was specifically meant to encourage and reinforce. In addition, it strengthens our earlier observation that triggers, such as dancers and volunteers, appear to fulfil a key motivational role, even in the (temporary) absence of an interactive system.

Design Consideration. Sudden disruptions in the interactivity of a system have the potential to positively influence engagement by way of creating an ambiguous situation that challenges participants to focus their attention to interpreting their own behaviour. We propose further research is required to investigate the impact of such unannounced interaction shifts on user behaviour, such as in terms of severity, frequency, persistence, and the potential boundaries between user frustration and curiousness. Here, we highlight that the impact

of triggers is still relatively undervalued and underexposed, even though they appear to be crucial components of interactive systems.

6.6.4 Committing: From Participant to Actor

We observed that *Encounters* engaged participants through audiovisual feedback and dance performances, as well as through social interaction with each other. Participants who discovered the cause-and-effect narratives in *Encounters* committed to more persistent and dedicated forms of interaction: '*It got us all excited when we discovered that we could manipulate the visuals even more when we held hands with friends.*' (interview #3, two middle-aged couples). As participants were empowered to discover how the installation responded to performative and social interactions, they transformed into actors.

The Narrative of Participation. We observed participants transform into actors in two distinct ways: through participating in the dance performance and by initiating interactions with others. The second dance phase by facilitators temporarily orchestrated the engagement of participants. For instance, the choreography contained dance expressions that motivated participants to stand close together, and engage in activities like running, jumping or touching each other. As some participants became sufficiently empowered, they took on a role as actors and started manipulating the predefined choreography of the dancers: '*In my zone, people didn't want to form a cluster. [...] I kept orbiting around them. In the end I appreciated being part of their experience, but not creating their experience*', interview #10, dancer).

In order to fully explore the unpredictable responsive nature of sounds and visuals, some participants merged efforts to create group-level behaviours, such as maintaining close physical contact, or standing as far apart as possible. These collaborative behaviours happened within groups of relatives ('*[...] We tried to identify if there was a shape that was following us and I think there was. So we separated again to see if that was the case*', interview #20, middle-aged couple); between strangers (e.g. '*While trying to work it out, I held hands with others. It changed us into a big planet on the screen*', interview #6, young couple); and in collaboration with dancers (e.g. '*I imitated the dancers' moves. Its easy, and I get to see what is possible with the visuals on the screen*', interview #17, young adult).

Design Consideration. The transition from participant to actor requires a level of commitment that allows people to feel sufficiently empowered to immerse in their interaction and experiment with the possibilities of a system. Therefore, besides considering open-ended interaction mechanisms, triggers fulfil a particular role in easing the transition from participant to actor. Through their inside knowledge of an interactive system, triggers support a narrative for participants to immerse in, and, subsequently, facilitate opportunities for social and performative interaction between actors and triggers, and among groups of actors.

Collaborative Performances. At one occasion, a group of friends entered a dance zone and, after an initial phase of exploration, passed around a beach ball at each other (see figure 6.10). A subsequent interview revealed these participants aimed to explore the sensors capabilities: '*It was fun! We could see that the sensors picked up the ball as we passed it around*' (interview #16, group of friends). This improvisation positively impacted the social interaction, as two other participants joined in. On the other hand, the dance performance that started shortly thereafter required significant adjustment, as dancers were confronted

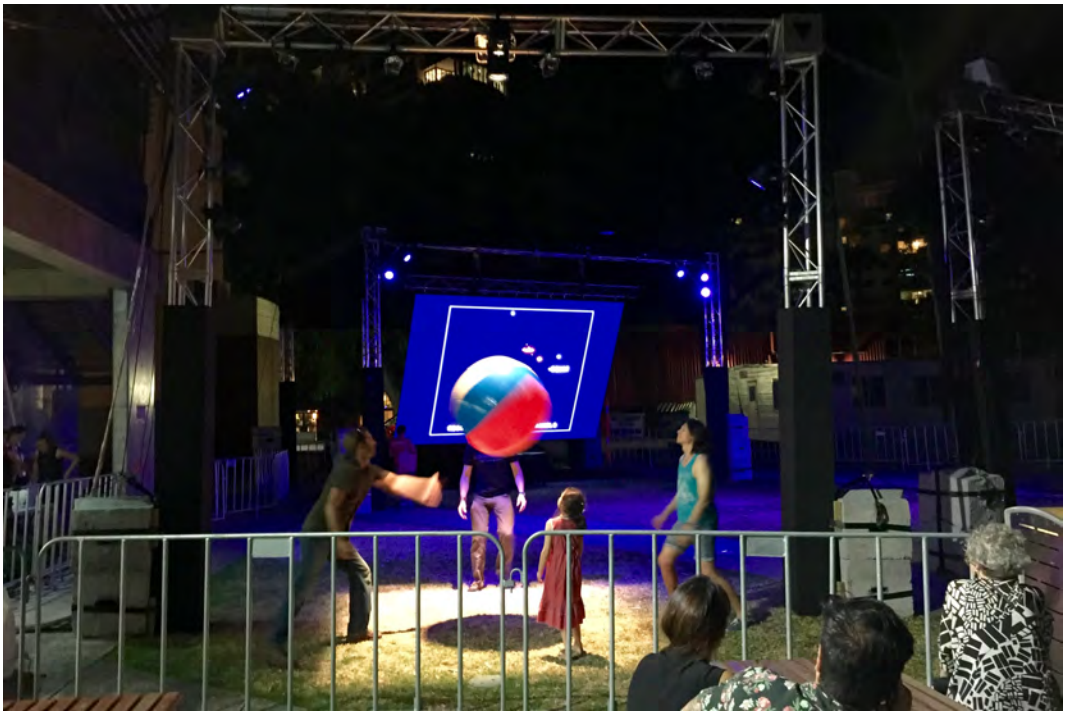


Figure 6.10: A collaborative performance, in the form of two groups of actors throwing a beach ball at each other.

with insufficient space in the dance zone to perform. Yet, as the honeypot sweet spot was already at its maximum, this particular dance became also relatively purposeless.

Design Consideration. In order to encourage collaborative behaviour, a systems interactivity should motivate people to join efforts, in order to discover (hidden) features and positively influence the overall social experience. Design considerations involve forms of gamification that encourage deliberate and synchronous activities, in terms of technical features (e.g. software that recognises collaborative actions), experience (e.g. visual and sonic feedback that responds to collaboration) and physical manifestations (e.g. providing *props* that require participants to collaborate). In this context, providing participants with detailed information about the system would increase the usability, yet might hinder the emergence of collaborative performances and more elaborate experimentations. However, collaboration may also hinder the engagement of others, or even the performance of the system in itself. As such, in order to accommodate a wide range of participants, one should consider spatial aspects (e.g. maximising the dance zone) and technical features (e.g. responding meaningfully to varying levels of engagement).

6.6.5 Dropping Out: Transitioning Out of Engagement

We observed people dropping out of *Encounters* for various reasons, which differed in terms of their prior user role.

- **Unwillingness** occurs among passers-by who have not (yet) experienced the interactive system, and where a general disinterest or discomfort (e.g. loudness, queuing, time constraints) might exist.

- **Disappointment** is caused by a contradiction between personal expectations and the actual experience, such as by feeling underwhelmed by the feedback or the general purpose of the interaction, which could be caused, among other reasons, by usability or user experience issues.

- **Discomfort** occurs as audience members have been unsuccessful in overcoming social fears (e.g. unfamiliarity, crowdedness). It mostly relates to a misalignment between personal expectations and what the system supports (e.g. a system requires excessive gestures, which an audience member is unwilling to perform for reasons such as social awkwardness or bodily constraints).

- **Withdrawal** occurs when participants spent some time in the interaction zone, but drop out prior to transitioning to actor because of physical limitations (e.g. exhaustion) or spatial and social influences (e.g. perceived sense of crowdedness).

- **Completion** is the canonical reason for dropping out: participants progressed through the complete narrative of the interactive system, or conclude that they depleted all possible, expected or interesting interaction possibilities.

Design Consideration. Interactive systems need to be designed to avoid dropouts for external reasons, like limited usability or insufficient enjoyment. Systems should integrate gentle ways to abandon engagement and allow for different degrees of commitment with a system. Despite dropping out, specific trajectories can encourage dropouts to recommit into the canonical trajectory. Here, one can consider deploying triggers that attempt to relieve discomfort or deal with disappointment by disclosing or demonstrating the interactions that are supported by the system. We believe such interactions should highlight the general purpose of the system for potential engagement to (re)emerge, and refrain from posing additional challenges. Notably, if dropouts are to recommit, such trajectories should not have any social or other negative repercussions.

Social Interaction while Dropping Out.

We observed that social interaction between dropouts and other users can take implicit forms, such as showing visible signs of physical exhaustion. More explicit forms of communication consist of dropouts who communicate their experiences with the people they pass in other stages of the trajectory, or bystanders who pick up on enthusiastic conversations between groups of dropouts. We thus distinguish between three types of social interaction.

- **Unintended guidance** occurs when passers-by are influenced, commonly involving overhearing conversations between dropouts, but can also involve reading status updates from dropouts on social networks.

- **Purposeful guidance** is an explicit interaction, when bystanders and audience members exchange information with dropouts, predominantly on the inner workings of a system or peoples past experiences.

- **Performative guidance** occurs when participants and actors change behaviour in response to the physical behaviour of dropouts. It resembles some form of social risk assessment, such as when an actor stays behind in a dance zone as another actor suddenly drops out.

Design Consideration. Dropouts built up a particular experience that could be shared to those in other user roles. In fact, dropouts may easily and organically take on a role of *spark* or *facilitator*, enthusing those who have yet to engage in the interaction and sharing their insights and experience. Such interactions with other user roles can be encouraged by physically forcing them to meet or pass each other when dropping out, or by promoting collaboration with those who are not yet participating. Naturally, social interaction may be detrimental when dropouts report negative experiences to others, such as the reasons for dropping out that were mentioned earlier. However, we believe the role of dropouts is still underexposed in HCI, and suggest further research is required to investigate their effect on participant trajectories.

6.7 Discussion

Our analysis yields new insights into the key factors of the honeypot effect, while still remaining flexible for adaptation and deployment in other application domains.

6.7.1 Triggering Audience Engagement

In the absence of any engaging activities or pre-existing participants (for example when a system is initially launched), motivating new participants to move closer and engage in an interaction becomes more challenging as the risk of social embarrassment is perceived to be higher. The Honeypot Model provides a framework that allows for simultaneously analysing how triggers *influence* the *trajectory* of people, respectively through their behaviour and spatial position. In addition, *Encounters* was characterised by a range of distinct triggers, unique in their temporality, sociality and proximity to the interaction zone. The ability of the Honeypot Model to accommodate such complex aspects, reveals its flexibility as an overall framework that describes but not prescribes the honeypot effect.

However, while triggers in *Encounters* influenced engagement by *informing* passers-by, *motivating* participants and *orchestrating* actors, other studies could consider how triggers can be utilised in different contexts. For example, amusement parks may need triggers that entertain queuing *audience members*, while street performers may rely on persons planted in the audience to orchestrate *bystanders* into cheering.

6.7.2 Promoting and Sustaining Engagement

As soon as some form of engagement with a system has been achieved, the challenge is to allow for different forms of engagement to emerge, and allow for their co-existence and sustainability over longer periods of time. In our model, we propose the *activation loop*, a trajectory that is crucial in activating new participants to join the interaction, and allowing dropouts to share experiences or recommit. The *activation loop* should not be understood as a mechanism that continuously pulls dropouts back into participation, but rather as an exchange of knowledge and motivation between those that interact (i.e. participants and actors) and those who are yet to engage in the interaction (i.e. bystanders and audience members).

Our analysis of the activation loop expands the common notion of the honeypot effect as solely relying on watching others. In fact, we argue the activation loop is one of its key

elements, as the activities that occur allow for: 1) information to be exchanged between experienced dropouts and new participants to stimulate engagement (e.g. by sharing experiences), 2) bystanders and audience members to learn about the social norms and interactive features by observing the activities of participants and actors, and 3) dropouts to re-engage with the system after an initial period of withdrawal (e.g. to learn more about the supported features or social norms). We illustrated that the activation loop relies on communication between different user roles.

However, there exists a limit to promoting engagement. We identified a *honeypot sweet spot*; a natural equilibrium between the participation rate and system-specific constraints. We believe additional research is required to study the diversity of the honeypot sweet spot, such as its impact, optimisation and applicability in varying contexts.

6.7.3 Future Work

We believe that the Honeypot Model may prove fruitful when studying engagement in other contexts that rely on, or deal with, audience flows. Potential application domains span a wide array of contexts, ranging from street performances and media architecture, to urban games and mass tourist attractions. For example, amusement parks can apply the model to study how efficient transition through the activation loop can minimise waiting times; or public displays in community settings may require maximising the activation loop to create opportunities for social interaction.

6.8 Chapter Summary

In this chapter, we propose that the honeypot effect involves a series of spatial trajectories and contextual influences that should be modelled from well before the actual interaction takes place. Designing for a honeypot effect involves balancing the activation loop with the honeypot sweet spot. While the activation loop stimulates audience engagement, the honeypot sweet spot reduces the potential reach. However, the capacity of the honeypot sweet spot can be optimised by considering four design characteristics:

- optimising the physical environment, by considering a range of ergonomic, spatial, technical and social aspects;
- deploying triggers to ease transitions between user roles;
- stimulating opportunities for collaborative interaction, peer learning and exploratory activities; and
- allowing for dropouts to leave without any repercussion, or empowering them to reactivate within the *activation loop* and to stimulate those who have yet to engage.

Our contributions and design implications are synthesised in the Honeypot Model, a spatiotemporal model that can be used by designers and researchers to annotate and optimise the impact of the honeypot effect. The Honeypot Model allows for the identification and study of different engagement styles, ranging from active and self-reinforcing, to passive and individual.

7

Study IV.
Stories of Exile

This chapter will be submitted to:

This chapter has not previously been published, but will be submitted to a relevant peer-reviewed conference venue at a later date.

My contributions:
In this study, I took the lead in laying out the research objectives and methodology, conducting the participatory design workshops and analysing the qualitative feedback. The projection mapping contained images produced by refugees and was animated by Sandy Claes in *Adobe After Effects*. Interaction modalities were implemented by myself and overlaid onto the final animation video, by way of a *Processing* sketch (*Java*). The on-site projection mapping setup was delivered and set up by *Beam Inc.*[1]. I took the lead in acquiring the necessary permits for the projection mapping from local authorities and regional refugee agencies. Sandy Claes assisted in the qualitative data collection through interviews. Both Sandy Claes and Andrew Vande Moere assisted in authoring the publication.

Significance and value:
Findings from this study reveal the potential for media architecture to serve as a vehicle for social relevance. Our study demonstrates the potential of media architecture to alter the experiential and material qualities of public space, by encouraging people to reinterpret space and its meaning within a larger societal discussion. Findings from our study are relevant to architects, designers and social organisations that aim to embrace media architecture as a situated platform to alter the significance of its context by acting as an interface for social purposes.

Study limitations:
Our in-the-wild field study was conducted during two consecutive nights in summer. As a result, the public projection could only start after 10PM. While the late starting time aligned with the end of the Ramadan evening prayer of most refugees, it prevented most local residents to visit the projection mapping and to interact with refugees. As a result, the starting time posed challenges to our initial ambition to facilitate interactions between refugees and Belgian citizens.

[1] http://www.beam-inc.eu

7.1 Abstract

The current global refugee crisis creates novel opportunities for technology to support interaction between refugees and members of their host communities. In this paper, we describe the design and evaluation of *Stories of Exile*, an interactive media architecture installation that depicted the displacement of refugees onto the facade of a refugee shelter. We report on the involvement of refugees in a participatory design process and the subsequent in-the-wild field study.

Our analysis indicates the potential of employing media architecture as a socially relevant medium, but also illustrates how context raises new challenges for media architecture in terms of adhering to the norms and expectations of those involved, such as refugees and local citizens. We also reveal how participatory design with refugees challenges the researcher, particularly in terms of methodological flexibility.

7.2 Motivation

Research endeavours in the field of urban HCI and urban informatics increasingly turn towards addressing social causes, such as ageing [Waycott et al., 2015], homelessness [Le Dantec and Edwards, 2008] and domestic violence [Clarke et al., 2013]. These studies highlight the importance of empowering people in their lives, by providing new and specific ways to build, restore and sustain meaningful relationships with other members of society, via their urban or digital social networks. Today, these opportunities gained an additional sense of urgency, as close to 1.5 million people claimed asylum in the European Union after becoming displaced because of armed conflicts or for fear of religious or ethnic persecution [Ratha et al., 2016].

Despite now living in safe environments, refugees still face challenges to integrate into host communities, mainly hampered by linguistic barriers and social differences. In addition, the influx of refugees has caused social discord in several European countries. Several grassroots initiatives emerged in response to support newly arrived refugees, such as in their search for shelter and employment [Baranoff et al., 2015; Quirke, 2012] and in forming new networks with local citizens [Temple and Moran, 2005; Yerousis et al., 2015]. Their appearances range from low-threshold applications for mobile phones [Brown and Grinter, 2016] to interventions in public space, as an environment that represents local standards and rules of interaction [McCarthy and Wright, 2005].

We believe there is a need for more initiatives that seek to empower refugees in engaging with the surrounding community. In light of the recent understanding that ubiquitous computing is able to amplify the experiences of contemporary urban life [Paulos and Beckmann, 2006] we recognise opportunities for media architecture to empower refugees. Here, architecture becomes a dynamic vehicle to communicate information to the immediate vicinity. Its situated character, inherent dynamic qualities and visually spectacular appearance enable media architecture to transform social relations and stimulate emerging and unforeseen use of public space [Dalsgaard and Halskov, 2010]. Most current manifestations are driven by commercial, artistic or entertainment objectives. However, we asked ourselves how media architecture is able to fulfil social purposes, by becoming a vehicle for communicating some of today's most urgent societal concerns.

Figure 7.1: The refugee shelter is located in the village centre, within walking distance from a central square. It is set back from the main street by an approximately 50m long and narrow laneway, which is not accessed by local citizens.

To explore the concept of media architecture for social purposes and to gain insights into the qualities and challenges of such an endeavour, we invited refugees to participate in designing media architecture for their refugee shelter. Together, we developed *Stories of Exile*, a large scale interactive projection that was publicly presented during two successive evenings. In this paper, we discuss how the participation process of refugees informed the design of our in-the-wild case study and we critically discuss how the public screening affected local community members and refugees in their interactions. Our insights provide further understanding to the role of the surrounding architectural, social, political and cultural context in influencing the significance of media architecture for social purposes.

7.3 Design Process

We invited refugees from a refugee shelter in Zwijndrecht, a mid-sized municipality in Belgium of approximately 19,000 inhabitants, to participate in a series of design workshops. Currently, 150 refugees live in the shelter, predominantly families with children, with a large majority originating from the Middle East and Eastern Africa.

The shelter is located in a former nursing home that occupies the inner area of a large residential block. The only access is provided through a 50m long and narrow alleyway, where staff members typically park cars (see Figure 7.1). At the initiative of the municipality and in light of the refugee crisis, the nursing home was reconverted into a temporary refugee shelter in December 2015. Its central location in the village provides refugees with easy access to public transport and a large communal square.

Table 7.1: Participant demographics for each workshop session.

Session	Participants			Researchers
Diagnosis	3 Male	Pakistan	Late 20s	2
	1 Female	social worker	Late 20s	
Action #1	2 Male	Afghanistan	Early 20s	2
	1 Female	Afghanistan	Early 20s	
Action #2	1 Male	Guinea	Early 60s	1
	1 Male	Somalia	Late 20s	
	1 Male	Afghanistan	Early 50s	
	1 Female	Afghanistan	Early 40s	
	1 Female	social worker	Early 40s	
Action #3	1 Male	Somalia	Late 20s	1
	1 Male	Burundi	Early 20s	
	1 Male	Rwanda	Early 20s	
	1 Female	social worker	Early 40s	
Design	1 Male	Somalia	Late 20s	2
	1 Male	Burundi	Early 20s	
	1 Male	Rwanda	Early 20s	
	1 Male	Afghanistan	Early 50s	

7.3.1 Design Workshops

The invitation to participate in our design workshops was advertised in the refugee shelter in English and Standard Arabic. The workshops were presented as having a twofold goal: 1) an opportunity to collaboratively reflect on the individual experiences of migrating to and living in Belgium; and 2) to communicate these experiences with the neighbourhood by way of a projection onto the facade of the shelter. 15 refugees and 3 staff members were interested in participating. We organised five workshop sessions, that were based upon the phases of Participatory Action Research, including Problem Formulation, Action Planning and Action Taking (see Table 7.1) [Bilandzic and Venable, 2011].

Problem Formulation. A single diagnostic session aimed to uncover the problem domain. Participants were invited to respond to three questions to uncover their appreciation of 1) Belgium and the neighbourhood surrounding the shelter; 2) the refugee shelter; and 3) themselves and their family. We envisioned feedback to elicit novel perspectives into the current living conditions of refugees.

- **Outcome.** Sharing insights about Belgium and the new neighbourhood proved most inspiring for refugees. They revealed some of the differences with their country of origin and shared some of their most surprising observations, such as contrasting habits and values. We learned that refugees talked about the cultural contrasts by using several common descriptions of emotion, such as happiness, sadness and hopefulness.

Action Planning. Based on Problem Formulation, we prepared questions to elicit further emotional feedback, such as '*Upon arrival, this made me happy*', '*Upon arrival, this was new to me*', '*Upon arrival, this was strange*', '*Upon arrival, this made me sad*' and '*Upon arrival, this made me hopeful*'. We organised three Action Planning workshop sessions, and invited refugees to reflect upon three questions that differed for each workshop session. In order to spark imagination, we provided each participant with a sticker sheet that contained small pictograms of common themes, such as food culture, language, architecture and security (see Figure 7.2).

Figure 7.2: A sticker sheet with 42 icons representing a wide range of Belgian themes supported refugees in formulating answers during the Action Planning phase.

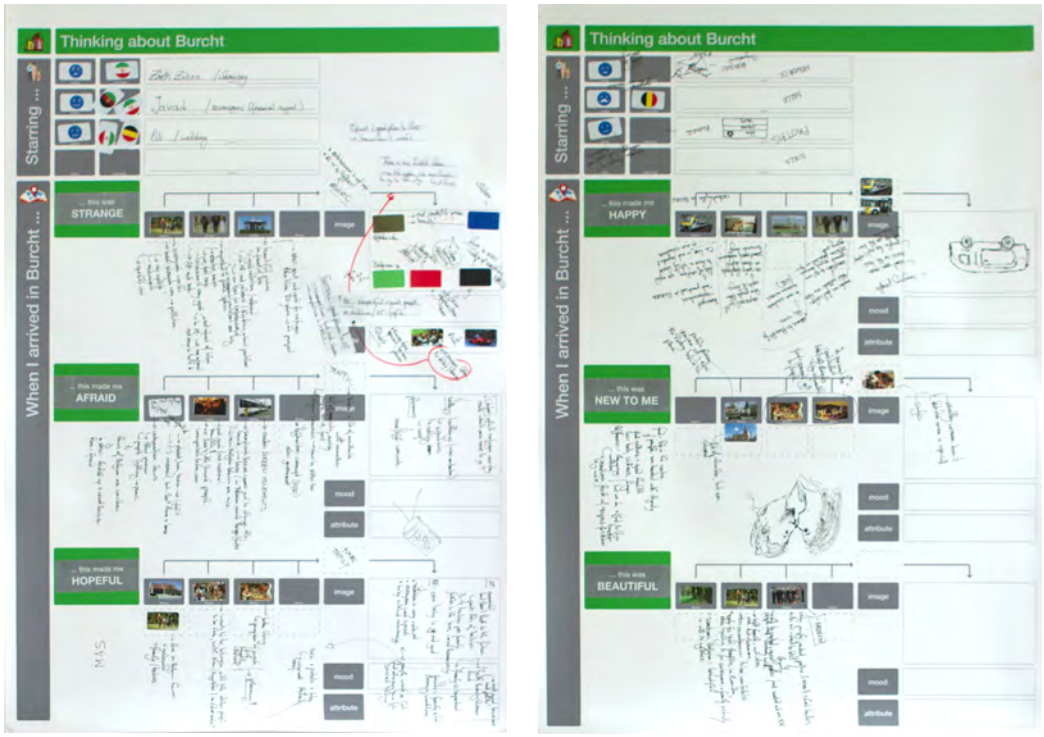


Figure 7.3: All discussions during the *Action Planning* sessions were archived and further annotated onto large sheets. Participants also used the sheets for sketching relevant illustrations.

Figure 7.4: Design session with refugees, involving a series of themes and annotations by way of sketches and keywords.

- **Outcome.** Upon selecting a pictogram, participants placed it onto a large paper sheet onto which all further discussions were annotated and illustrated (see figure 7.3). Open coding was later used to categorise discussion and annotations into ten action themes: *food*, *security*, *peace*, *dignity*, *family life*, *buildings*, *religion*, *silence*, *nature* and *anger*.

Action Taking. Based on previous commitment four participants were re-invited to take part in a participatory design session. They were familiarised with the concept of media architecture by introducing three existing projects by artist collective *Urbanscreen* [Kronhagel, 2010]. Then, each participant was asked to pick one of the ten action themes, discuss what the theme signified for them, and reflect on opportunities to communicate the theme and the associated feelings to the outside world.

- **Outcome.** Researchers helped participants in finding an action theme to work on, largely based on the input from their previous involvement. Ultimately, the consensus was to work on *security*, *religion*, *silence* and *peace*. In explaining their personal interpretation of the themes to each other, participants shared stories that were rooted in individual history and personal experiences. Group discussions spontaneously emerged and added further detail to these stories. Participants and researchers took notes of the final outcomes by drawing and sketching (see figure 7.4).

  – As soon as a set of sketches and drawings was available, we invited participants to imagine novel ways to represent the images onto the facade of the refugee shelter. Participants recognised strong similarities between the drawings and their relevance within the four key timeframes in their displacement (i.e. chaos, cross-

ing borders, crossing seas and finding refuge), but failed to develop a consistent scenario for the final projection mapping.

– The introduction to media architecture helped one participant recognise the potential of using some of the refugee shelter's architectural features for the intended projection mapping. He had noticed similarities in the rhythm of its window configuration and that of his former house in Afghanistan. He envisioned windows to provide perspectives onto violence and killing, as he had witnessed for himself.

7.3.2 Design Requirements

Based on the set of sketches and drawings, and the recognition of some architectural features, we designed and developed a storyline that combined the four key timeframes in displacement as adjoining chapters. We envisioned the video to encourage passers-by to move towards the refugee shelter's entrance and uncover details of the storyline as they walked past.

Pictorial requirements. All artefacts that were drawn during the workshops were vectorised, animated, and used as dynamic artefacts in the appropriate chapter of a video. We chose to maintain the original hand drawn aesthetic, as an affordance to depersonalise the personal nature of the video fragments.

Architectural requirements. Facades and adjacent spaces were carefully selected for the projection mapping to stimulate social interactions with the surrounding community [Fischer and Hornecker, 2012]. We required the projection mapping surface to trigger sufficient curiosity among passers-by (*Activation Space*) in order to enable interaction (*Interaction Space*), and provide comfortable access to a *Social Interaction Space* where local residents could interact with refugees. Ultimately, we selected four adjacent outdoor walls of the alleyway leading to the entrance of the refugee shelter, resulting in a total projection surface of 26.27m *x* 2.92m (5,452px *x* 584px).

Interaction requirements. The projection was conceived to fully cover the four walls in order to depict each of the four key timeframes in displacement. In order to encourage passers-by to move along the projection wall towards the refugee shelter's entrance, we integrated a layer of interactivity. In its resting phase, the 1-minute looping video was hidden by an overlaid grid of black rectangles, following the rhythm of the facades' existing windows (see Figure 7.5). In its listening phase, rectangles shrunk when people walked or stood in front of the movie, thereby exponentially exposing the underlying video fragment (see figure 7.6).

7.3.3 Public Screening

The projection took place from 10PM to 2AM on two successive evenings, to cater for the Ramadan prayer times and to guarantee a sufficiently low ambient lighting. Some refugees provided self-made coffee, tea and biscuits on the first evening in the *Social Interaction Space* nearest to the refugee shelter's entrance, after community members had walked across the

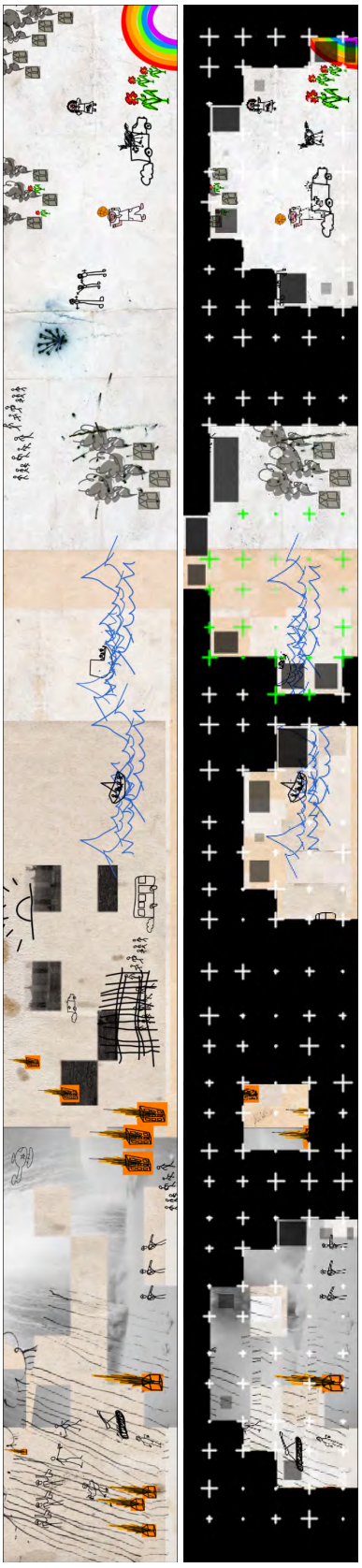


Figure 7.5: *Stories of Exile* consisted of a building-sized interactive projection mapping that depicted refugees' itineraries from chaos in wartime to comfort in finding refuge. Parts of the complete visuals (top image) only emerged as passers-by moved and stood still in front of the projection mapping (bottom image).

Figure 7.6: The listening phase of the projection allowed for local residents to immerse themselves in the storyline of *Stories of Exile* by slowly exploring its narrative, such as the chaos chapter with various references to wartime situations.

Interaction Space. The refugees also distributed flyers in the immediate area around the shelter, to advertise the projection mapping.

The projection setup consisted of 2 Barco HDX-W20 projectors, each able to provide 20,000 lumen light output. In addition, an AV Stumpfl control system distributed a single data feed with the interactive video to the projectors, and mapped the video onto the building. The setup required a dedicated 380V power unit on-site.

7.3.4 Data Collection

Researchers observed and took notes about the behaviour of local residents and refugees within the various spaces around the projection. Semi-structured interviews invited people to express feelings that the projection and the refugee crisis provoked with them. We conducted 8 on-site interviews with local residents (L) and 4 with refugees (R).

7.4 Discussion

In this section, we share insights into the opportunities and challenges for media architecture to become an intercultural interface for communication and social purposes.

7.4.1 Role of Content

Local residents experienced the imagery of the video as confronting and, without any prior or subsequent explanation, recognised the narrative: '*their life, then and now*' (L4). Even though the refugee shelter was established several months prior to our study, the content of the video '*personalised many of the refugees who we had seen before, but never really got to know*' (L7). On some occasions, local residents indicated becoming emotional upon viewing the projection, as '*the chaos [of war] became much more tangible*' (L5, L6), in particular because of the interactivity ('*I seemed to be part of the story*', L5). We also observed that most people tended not to just walk past or briefly interact with *Stories of Exile*, but instead paid close attention to the various components of the storyline.

Refugees experienced content in two distinct ways. First, as the chaos chapter contained imagery of tanks, air raids and even gun fights, we received a dual response. R1 and R4 pointed out that they found the images '*too confronting*', as it '*transported them back*' (R4). Interestingly, R2 and R3 considered the chaos chapter to be '*too romanticised*', and suggested to add more explicit artefacts. A brief discussion ensued between R3 and a workshop participant, who explained that the movie was not intended to represent real-life circumstances, but instead raise awareness among local citizens. Through these different interpretations and points of view, a collective space for dialogues and conversations organically emerged. Second, R2, R4 and L3 expressed an interest in seeing the next chapter; the future, including life in the refugee shelter and the years to come. As such, the social narrative of *Stories of Exile* raised concerns towards the sustained relevance of content and its potential adaptation over time.

Most media architecture serves commercial, artistic or entertainment purposes, and tends to create ephemeral connections between the message and its viewer. However, media architecture for social purposes creates emotional experiences that go beyond the typical physical and embodied relations [Brynskov et al., 2009]. As such, content becomes critical: norms, expectations and interpretations may differ across cultures and over time. Hence, mechanisms that allow for participation in the design, maintenance and review of content for social purposes, empowers relevant stakeholders in taking ownership.

7.4.2 Role of the Carrier

Stories of Exile was purposefully contextualised by projecting onto the facade of a refugee shelter. For citizens, it was obvious that the storyline pertained to the current refugee crisis and, more specifically, '*the new neighbours*' (L6). For refugees, the projection onto the shelter was an '*ice-breaker to come outside*' (R1) and to talk with local citizens. '*Their*' shelter and current home suddenly became a movie theatre that showed '*their*' movie. Refugees recognised the relevance of projecting onto walls and facades of the refugee shelter. For them, the projection was more than a rectangular display. In fact, '*walls had to be taken down and climbed*' to finally find refuge, often as a direct consequence of some scenes of the projection (R4).

The societal and functional role of the carrier is instrumental in affecting the contextual effect of media architecture. However, next to an obvious architectural impact, maximising the role of the carrier in media architecture has implications on a social, urban and even political and societal scale. We portrayed the refugee crisis in its most explicit form (social scale) in the heart of a municipality (urban scale) where the presence of refugees has pre-

viously sparked debate and discord (political scale), especially amid a climate of additional concerns, such as the effects of the elevated national threat level (societal scale).

7.4.3 Role of the Environment

Deploying media architecture in a small and calm community introduced the challenge of reaching a representative sample of the population. In addition, projection mappings require sufficiently low ambient lighting, which in summer only allowed us to start projecting from 10PM onwards. Most local residents tended to be indoors around this time, but most refugees came outside as the evening prayer had just ended. Both conditions resulted in a low number of local onlookers ($n \approx 60$), and a small number of people conversing ($n \approx 15$) with the refugees that stood outside at any given time. The presence of food and drinks on the first evening motivated local residents to walk along the projection towards the refugee shelter's entrance. Culinary traditions proved to be a conversation starter, successively extending to sharing cultural values, local knowledge and family experiences (L8, L5).

Despite the small community, we had imagined the projection to motivate a larger part of the local population to pass by, interact with the narrative, and interact with the refugees. The ongoing political and social debate surrounding the refugee crisis, was probably sufficient reason for some to not visit, come closer or explore (L2). However, the large, bright public installation foiled the initial skepticism of some. Highlighting social issues through media architecture goes beyond augmenting the experience of public space, but particularly appeals to the public awareness on a specific concern. As a result, the surrounding social-cultural fabric seems instrumental in affecting the impact of media architecture. We propose further research is required to investigate how a larger population can be addressed, and how any social, political, cultural or technological barriers can be overcome.

7.4.4 Role of the Researcher

Throughout the design process, we, as researchers, observed that some degree of control had to be given up, in favor of a deeper and more meaningful relationship with the refugees. Giving up control is not a typical position of a design researcher, even though previous research has highlighted the qualities in the domain of socially engaged art [Clarke et al., 2016]. Being open to dealing with emergent or unexpected occurrences has however proven to make individuals feel treated as relevant, as their contributions are endorsed. For instance, while themes in the *Action Planning* and *Action Taking* phases were meant to provide a baseline for discussion, refugees regularly recounted stories that were not related to a theme, but were instead personal and at times traumatizing accounts of their recent past.

We learned that not cutting discussions short and, instead, providing them with a platform for open dialogue, created a sense of trust and understanding. In fact, we believe that many of the stories and experiences the refugees told, might not have been revealed if we had maintained our intended methodology. Our critical openness allowed us to become involved in the design process as people, and not just as academics with a research agenda. We also observed that participants were not as familiar with the concept of a workshop as most people in the Western culture are.

Time and effort, and at times improvisation and adaptation, were required to stimulate refugees in talking freely, such as about emotions, the (lack of) social services they could access, or the living conditions in the refugee shelter. In retrospect, we should have preempted that the lack of *free speech* is at times the cause of displacement for refugees, which might have inhibited their willingness to speak candidly. As such, while we believe that established methods have proven their applicability in our study, various ethical, moral, cultural and social challenges may require immediate adaptations to methods in order to yield valuable results within a participatory workshop.

7.5 Conclusion

There is a growing interest in technology that addresses some of today's global challenges. For instance, the refugee crisis creates opportunities for innovative tools that support refugees in their integration into host communities, especially in terms of supporting social networks to form. In this paper, we described the participatory design process and evaluation of *Stories of Exile*, an interactive projection mapping that aimed to trigger social interactions between refugees and the surrounding community.

Based on observations and interviews with refugees and local citizens, we indicated opportunities and challenges of such endeavours, in terms of 1) the nature and sustainability of the content that is shown; 2) the contextual significance of the carrier; 3) the social-cultural barriers within the environment; and 4) the dynamic role of the researcher who engages refugees in research. Despite some challenges along the way, we believe that our findings demonstrate a potential for media architecture to evolve into an intercultural interface that communicates social concerns.

Part III

Discussion and Perspectives

8 Conclusion

In this dissertation, we investigated how media architecture is able to stimulate and support social interaction. Findings from two theoretical studies and four in-the-wild field studies highlight the importance of designing dynamic and responsive forms of media architecture that are able to align with the ever-changing activities, requirements and characteristics of its surrounding context. We provided adaptable and reusable design strategies to address contextual challenges and to transform media architecture into a socially relevant and architecturally integrated medium.

In the first chapter, the scope of our research has been presented by introducing the various challenges that media architecture is currently confronted with, in terms of its architectural and social integration. Next to introducing the historical evolutions towards what is currently known as *media architecture*, we also introduced the current state of the art. Five main research questions have guided the research presented in this dissertation:

- **Q1 Architecture.** How can media architecture gain architectural relevance?
- **Q2 Content.** How can media architecture communicate locally relevant information?
- **Q3 Integration.** How can media architecture become more locally situated?
- **Q4 Engagement.** How can media architecture stimulate audience engagement?
- **Q5 Social Relevance.** How can media architecture gain social relevance?

Chapters 2 and 3 provided further theoretical understanding to the context of media architecture. Chapters 4, 5, 6 and 7 introduced case studies that each address specific sets of challenges: allowing citizens to control content, inviting citizens to participate in design, mapping the trajectories and influences that people experience in interactive installations and developing media architecture as an interface between communities. In each chapter, the objectives and design of prototypes were described and we reported on the outcomes, research contributions and emergent questions.

In this section we summarise our findings with the case studies and highlight opportunities for future research. We conclude with a critical reflection of the research approach that guided the doctoral study and close with the final remarks of this dissertation.

8.1 Study Contributions

In the following section, we describe the relationship between the five main research questions and the relevant findings from our design case studies.

8.1.1 Architecture (Q1)

In Chapters 2 and 3, we investigated the relationship between architecture and media architecture. We investigated a wide range of existing examples of media architecture. Our analysis revealed insights into the contextual characteristics of media architecture, as well as the distinct architectural qualities that are recognised (or amiss).

Both studies draw attention from designers to integrating media architecture within architecture and society in a durable and sustainable manner. For this, our first study (Chapter 2) has unfolded the significance of context and has provided a new understanding to the key characteristics that surround media architecture (i.e. environment, carrier and content). Our second study (Chapter 3) was concerned with providing further insight to the architectural qualities of media architecture. Our analysis highlighted the reciprocity between media architecture and architecture, as a measure for design quality. We also uncovered and laid out a terminology that has not previously been used in the media architecture discourse, containing concepts such as materiality, modularity, scenography and architectural contextualisation.

8.1.2 Content (Q2)

In our third study (Chapter 4), we determined a sustainable way to create and consume content on public displays exists in inviting citizens to do so for themselves. We made initial observations towards the particular local nature of content. Our study revealed the challenge to address the full spectrum of urban residents, and the complexity of dealing with various pre-existing norms, values and expectations that complicate the common understanding of messages. We suggested new processes for shared control over messages on public displays, as a method to 1) overcome feelings of being excluded in terms of control and supervision; 2) prevent a decline in actual use of the system over time; and 3) warrant their local relevance.

Additionally, the analysis of *StreetTalk* (Chapter 5) has yielded more insight into the notion of hyperlocal messaging, i.e. forms of communication that are situated in a community with a primary focus directed towards the concerns of the community members so as to gain local relevance. We revealed how hyperlocal content engages locals and passers-by to interact with media architecture and with each other, as it created a sense of trust and credibility.

8.1.3 Integration (Q3)

The methodology of *StreetTalk* (Chapter 5), in which household were engaged to participate in conceiving, designing and managing a set of situated public displays, opened up the design space of public displays, beyond their prototypical rectangular shape and screen-based format. Our analysis yielded new insights into the role of participatory design as a way to warrant the local situatedness and acceptance of media architecture by local communities. Based on our analysis, we introduced a series of design recommendations for future endeavours in the realm of situated public displays. Our findings show the opportunities that exist in terms of 1) sustaining engagement; 2) conveying a sense of trust and credibility; 3) supporting accessibility; 4) arousing curiosity; and 5) warranting local situatedness and relevance.

8.1.4 Engagement (Q4)

Our research provided insight into the trajectories and influences that affect the success of the honeypot effect. Our study of *Encounters* (Chapter 6) has provided further understanding to 1) the elements that stimulate people to transition between phases of engagement; 2) the various factors that drive the honeypot effect; and 3) the constraints to the self-reinforcing performance of the honeypot effect. We introduced the notion of a honeypot sweet spot; i.e. the optimal number that can simultaneously interact. Our findings add significance to previous findings that promote the self-reinforcing nature of the honeypot effect.

We provided design considerations for the main trajectories in interactive installations, and reveal how to optimise the performance of the honeypot sweet spot by 1) enhancing the physical environment of an interactive installation; 2) deploying triggers to ease the transitions between user roles; 3) stimulating opportunities for collaboration; and 4) allowing for dropouts to leave, reactivate or stimulate new users to transition towards interaction.

8.1.5 Social Relevance (Q5)

In light of the recent refugee crisis in Western Europe, we invited refugees to participate in the design of media architecture for social purposes (Chapter 7). Our study has combined insights into citizen-control, hyperlocality, participatory design and engagement. Our study has revealed a range of opportunities and challenges for contextualisation of socially relevant media architecture. Further analysis allowed us to provide some design considerations, in terms of 1) the nature and sustainability of the content that is shown; 2) the contextual significance of the carrier; 3) the social-cultural barriers within the environment; and 4) the dynamic role of the researcher who engages refugees in research.

8.2 Discussion

Our case studies allowed us to explore a range of potentials, challenges and design situations for media architecture in distinct social and architectural environments. While Part 1 (chapters 2 and 3) provided insights into the qualities of media architecture, Part 2 laid out four exploratory design studies that approached where the design space of media architecture with an open perspective. Key to our approach was the involvement of non-expert users in the design process of media architecture, which we proved to incite curiosity to approach, explore and engage in interactions with media architecture and the surrounding residents. We provided adaptable and reusable design strategies to address contextual challenges and to transform media architecture into a socially relevant and architecturally integrated medium.

In this section we revisit eight key themes that emerged during our research and we reflect on their significance in forming a new understanding of contextualised media architecture. Our reflection aims to address all relevant stakeholders in the design, development and operation of media architecture. In order to provide practical guidelines, each section concludes with an overview of relevant design considerations that support contextualisation of media architecture.

8.2.1 Significance of Context

In each study we addressed a specific challenge with regards to the integration of media architecture within the urban and social fabric. While setting up case studies, during their deployment and when analysing results, we referred to the characteristics of the urban and social fabric as *context*. In fact, we described context by detailing a range of descriptors, such as the social-demographic composition of the environment, the architectural characteristics of a carrier, and the content that is considered meaningful for a location. As our studies progressed, findings revealed the breadth of design characteristics that should be investigated when contextualising media architecture, including:

- **Carrier**, i.e. the relation between media architecture and the physical characteristics of architecture that provides its structural, functional or aesthetic support;
- **Content**, i.e. the relation between media architecture and the technical and visual characteristics of the message that is communicated;
- **Environment**, i.e. the relation between media architecture and the specific social, cultural and demographic composition of its surrounding fabric;
- **Medium**, i.e. the relation between media architecture and the technological functionalities of its interface (e.g. the aesthetic qualities of a low resolution media facade versus the information capacity of a high resolution public display);
- **Interaction**, i.e. the relation between media architecture and the forms of user engagement and involvement that it aims to stimulate;
- **Quality**, i.e. the relation between media architecture and its integration within the built environment in order to amplify an architectural design rationale;

Design Considerations. One of the key considerations to warrant the success of media architecture is the thorough consideration of the surrounding context, as well as its possible transformations over time. Such considerations encompass media architecture for commercial purposes, social purposes, architectural purposes and cultural purposes.

- **How to investigate context?** Prior to designing, approving or constructing media architecture we recognise the need to chart the contextual characteristics that have a determinative effect on the visual, functional, informative, experiential and socialising quality of media architecture. This involves answering questions, such as
  - In which location can media architecture fulfil a significant local role? What is the appreciation of the location among citizens?
  - What message that media architecture communicates is relevant within the environment?
  - What limitations exist, such as in terms of the impact of the social-demographic fabric on the appreciation of the message (e.g. inappropriate information), or the impact of the cultural fabric on the architectural integration (e.g. heritage context)? Also, how does the message potentially affect the social-demographic fabric?

- What experience should media architecture create? What is the nature of the message (e.g. text and graphics versus ambient lighting) and which technical opportunities and limitations exist?

- What opportunities exist for media architecture to stimulate engagement among its audience, particularly in terms of promoting social activities through supporting specific interaction techniques?

- How does the design rationale of architecture affect the design of media architecture? Which design considerations are relevant for reaching a symbiosis between architecture and media architecture?

- **Can context change?** We have raised awareness to the need for media architecture to dynamically and responsively align with the ever-changing activities, requirements and characteristics of its surrounding context. As such, designing media architecture requires a readiness to manage the intrinsic dynamic nature of context. Changes in context may potentially cause challenges when aiming for durable social relevance and architectural integration. For instance, the social-demographic composition of a neighbourhood may change over time, thereby affecting the requirements with regards to content. Similarly, as new requirements for content emerge, the technical possibilities of an existing medium may no longer be sufficient and alternatives may have to be sought. These transitions may also occur during a single day, such as content requirements or interaction opportunities for specific user profiles during specific times of the day.

- **Where does context end?** Our list of contextual characteristics is based upon findings from our case studies. We believe that longer and more numerous deployments would reveal additional contextual characteristics and their particularities. For instance, deploying media architecture in historical environments may reveal the importance of heritage as a contextual characteristic (encompassing architectural and cultural factors) whereas media architecture in a commercial setting may raise the need to incorporate revenue recognition, such as the impact of media architecture on sales. As such, investigating context requires a critical openness towards the characteristics that determine its unique character.

8.2.2 Significance of Architecture

Our research took into account the skepticism about media architecture among architects. We were unsure about the reasoning behind it, and we were unaware why some media architecture comes across as 'successful' whereas others may seem to be 'added'. We revealed that much of the criticism relates to media architecture that has been retrofitted into existing architecture, with little to no appreciation for the intended design rationale or existing context.

By evaluating our findings through the lens of human-computer interaction, user-centred design and architectural design we have shown the importance of considering media architecture as a form of architecture, rather than a form of media. Formerly, its architectural significance was attributed to scale and public character. However, we have shown that 'successful' media architecture should be able to create atmospheres, to alter our interpretation of the built environment, and to affect the experience of the built environment in dynamic

and visually compelling ways. As a result, we believe media architecture belongs within the discipline of architecture. Unlike other disciplines that are significant components of the construction supply chain (e.g. electrical, plumbing, HVAC, carpentry) the qualities of media architecture stretch beyond managing and operating elements of the built environment. Instead, media architecture is instrumental in shaping the physical appearance, experience and communicative quality of architecture. As a result, we feel there is a need to support the emergence of *media architects*; experts in the domain of media architecture that advise and assist architects in the design process. These collaborations must promote a balance between the qualities of architecture and the qualities of digital media.

Buildings do not become architecture because of their size, solidity or permanence, but because they are gestural objects with cultural content, meaning, and significance [Wittgenstein, 1980; Kostof, 1985]. In fact, the term architecture is typically only applied to buildings that were designed with a view to aesthetic appeal, thereby creating a distinction between 'ordinary' buildings and 'high-status' buildings [Pevsner, 1943]. Our studies revealed that the architectural integration of electronic display media affects and relies on an overall architectural design rationale. As such, we feel encouraged to categorise media facades and integrated public displays as forms of media architecture, because of the meaning and social-cultural significance they embody. For instance, *Stories of Exile* captured many of today's societal challenges and aimed to increase awareness about the refugee crisis, and *StreetTalk* gained cultural meaning through communicating relevant content. In varying degrees, both studies have embraced the architectural significance of a carrier to strengthen the contextual relevance of media architecture. We showed that architecture defines the public perception of media architecture, and that media architecture in turn affects the public perception of the activities that architecture hosts. However, we raise objection to considering billboards as a form of media architecture. We argue that billboards should be distinguished on the basis of the temporary nature of what is on display and the clear intention of commercial gain in place of artistic merit or aesthetic appeal. Instead, media architecture and architecture have the capacity to create cultural meaning, but the transient nature of billboards limits their capability to only reflect cultural meaning.

Design Considerations. Media architecture is able to fulfil a role as embellishment of our cityscapes, if there is a strong connection with the surrounding context. Involvement of architects in the design process will result in a balance between the physical characteristics of media architecture and the architectural design rationale of the architecture that supports it.

- **Why should architects be supported?** We argue that the closer involvement of architects will enable more adventurous, interesting and inspiring endeavours that go beyond the traditional notion of rectangular and screen-based formats or as a medium that purely seeks attention of passers-by. Instead, their involvement must support the architectural integration of media architecture. As a result, media architecture will evolve away from location-agnostic and context-independent interfaces towards integrated, situated and locally relevant carriers of messages.

- **Who should support architects?** We feel that media architecture raises new challenges for architects, such as the range of new technical, functional, social and budgetary considerations. We have indicated a potential for *media architects* to support architects, but we reiterate the need to collaborate with the other stakeholders of media architecture, encompassing;

- citizens that benefit from media architecture, through its visual effect, informative value, entertaining quality, cultural meaning, or potential to provoke reflection;

- authorities that issue and continuously monitor building regulations, in order to optimise the lifespan of both architecture and media architecture;

- operators that assure the appropriate message is communicated to the right people, and that warrant a continuity in qualitative content throughout the total lifespan of media architecture; and

- interaction designers that implement engaging and sustainable strategies for citizens to interact with media architecture installations.

- **When should architects become involved?** In ideal circumstances, architects become involved prior to the approval or actual construction of media architecture. Accordingly, their involvement will ensure the integration of media architecture within the built environment and enhance the general credibility and sustainability of media architecture throughout the next generations. Failure to involve architects will continue to result in visually invasive digital interfaces that negatively affect the experience of the cityscape.

8.2.3 Significance of Community Involvement

Through its situatedness in public space, media architecture is able to affect our experience of the built environment. Quite literally, buildings and spaces are now displayed in a new light, hence contributing to the place-making process and becoming a medium for local messaging. Ideally, media architecture should allow people to engage with each other and experience spaces in new ways [McCullough, 2004]. One could argue that these are not necessarily "new" ways, but instead reclaim a wide range of values that have long-existed and have been well established in times when technology had not yet started to fundamentally influence urban life. As such, our studies have shown that media architecture in itself is able to reinvigorate qualities of public space as an environment that stimulates dialogue and social interaction, and that values a diversity of norms, interpretations and beliefs. Ultimately, such approaches should aim to improve acceptance, credibility and long-term sustainability of media architecture in public space.

Within each case study we have given citizens varying degrees of control over the content of the respective media architecture prototype; including text messages (*OpenWindow*), printed and audio messages (*StreetTalk*), visual feedback (*Encounters*) and contextual imagery projected onto a media facade (*Stories of Exile*). Our decision to involve communities was initially rooted in a lack of knowledge about the design characteristics and message that would be beneficial for a particular public space. Interestingly, our approach revealed that community involvement at all levels of the design process facilitated hyperlocal relevance and situatedness of media architecture, especially in terms of stimulating social cohesion, social interaction and engagement.

For instance, the local nature of messages triggered an initial interest, often succeeded by more personal interaction between urban residents. These interactions regularly enabled nearby residents to gain access to our prototypes, either directly (see Section 5.8.2: En-

gaging Neighbours in Interacting with Public Displays) or after some form of review and moderation (see Section 4.6.1: Social Interaction). We learned how several of these interactions have grown into long-term and still sustained social interactions in neighbourhoods, as they gave rise to launching discussion groups in the physical (e.g. knitting club) and virtual realm (e.g. Facebook community groups).

Design Considerations. Media architecture introduces promising opportunities to generate new relations with the urban environment, to build a relationship of trust with citizens, to allow individual interpretations to emerge, and to present locally relevant information. For this, close involvement of communities is vital.

- **Who controls media architecture?** Our findings highlight the importance of community control as a way to embed media architecture within its context. By providing citizens with a large degree of control over the message that media architecture conveys (including curation and moderation), content is likely to be more suitable for a particular environment and medium. While other control mechanisms may exist (e.g. by a commercial operator), we emphasise the importance of (also) involving local stakeholders.

- **How to integrate media architecture in a community?** Communicating locally relevant information plays a crucial role in the creation of spaces for dialogue and interaction [Dourish and Bell, 2007]. Our studies reveal that the local relevance of media architecture encourages citizens to act towards a more appropriated sense of place by conveying messages that relate to them, and by providing them with the opportunity to respond and react accordingly.

8.2.4 Significance of Participatory Design

From early on, we recognised a unique potential for close involvement of residents in the design of our study prototypes. In the domain of media architecture, end-user involvement has typically been limited to interacting with an artefact (e.g. [Leong and Brynskov, 2009; Brynskov et al., 2009; Boring et al., 2011; Schieck, 2005]). Commercial reasoning is still a major motivation behind most current media architecture installations [Struppek, 2010] and local authorities, outdoor media companies and corporate bodies still deploy media architecture with little to no involvement of citizens. Even though operators gradually start seeking innovative combinations between commercial ads and non-commercial information [Alt et al., 2012a; José and Cardoso, 2011], citizens themselves typically have little to no direct access to the well-shielded *black box* that controls most of today's media architecture manifestations.

However, for us, the deliberate choice to conduct in-the-wild field studies highlighted an opportunity to invite residents in participating and collaborating in designing and maintaining media architecture. In fact, previous research has highlighted the usefulness of 'participation in making' as a means to promote collective engagement and empower individual participants [Holmer et al., 2015]. *StreetTalk* has demonstrated the potential of allowing individual citizens and households to participate in the design of public displays. *Stories of Exile* has taken the participatory design approach further, by inviting multiple members of a minority community to participate.

Notably, the early involvement of citizens allowed us to gain invaluable insights into the particularities of the social, architectural and urban context we intended to design for, and to learn about previously unconsidered features or potentially disruptive usage scenarios. For instance, in *OpenWindow* the display system supported non-Western character sets, because household C raised a desire to address neighbours who only understood Arabic; in *StreetTalk* citizens interpreted media architecture far beyond its typical screen-based format; and in *Stories of Exile* a participant suggested to use the facade's window configuration as the grid for the projection mapping. Some of these insights might have been revealed by ourselves, but some would have required a substantial commitment to conduct longitudinal ethnographic research.

Design Considerations. We have approached media architecture from a *bottom up* perspective, by closely involving potential end users in the design and maintenance. Our research has revealed several new opportunities for a radical reconsideration of designing media architecture.

- **Why should communities be involved?** We argue for closely involving citizens and communities, as it has shown to stimulate the contextual integration of media architecture through an increased sense of ownership, augmented local relevance and renewed opportunities for social interaction. Communities should be empowered to design their own media architecture as a form of do-it-yourself urbanism [Ratto et al., 2014; Paulos et al., 2009]. Such ways should enable the fabrication of situated media architecture that is conscious of its surrounding social and architectural context, and that provides citizens with dynamic methods that sustain its long-term relevance.

- **How can communities become involved?** We believe there are opportunities for citizen- and community-driven deployments, where funding is provided by citizens themselves (e.g. crowdfunding), in collaboration with a local authority (e.g. public-private partnerships), or partly funded by commercial stakeholders (e.g. freeing time slots for local messaging on public displays in residential areas).

8.2.5 Significance of Sustainability

Our research initially emerged from the observation that an apparent lack in knowledge prohibited the articulation of efficacy and sustainability of media architecture. Concerns surrounding media architecture were typically assessed on a case-by-case basis and in most cases owners were forced to base their judgements on the advice from industry-specific stakeholders whose motives are predominantly commercial in nature. To the best of our knowledge, no sustainable practice had been established around even some of the most trivial issues, such as how location impacts performance, what the audience prefers in terms of content, how one should estimate the impact on road safety, or how changes in building occupancy might or should affect the message of media architecture. We believe that the skepticism among architects is a consequence of the uncertain sustainable nature of media architecture (in parallel with the rapid technological evolutions), contrary to the longevity that characterises most buildings.

Therefore, architectural integration of media architecture is not restricted to a range of aesthetic qualities. In fact, the potentially substantial (and permanent) effect on the cityscape requires media architecture to be intrinsically adaptable and responsive to changes, such as repurposing and obsolescence. One should even consider the effect of decay and demolition.

Obviously these requirements are under constant pressure, tensioned by increasing expectations of owners, critical opinions of the information-consuming public, and ever-changing innovations in display and interaction technologies. Despite the common assumption that most products nowadays reach end of life because they are no longer fashionable, they are superseded by more advanced technology, or they are broken beyond repair, media architecture – as a form of architecture – should not be considered as a disposable product.

Design Considerations. Even though disposability has become a consumer benefit [Cooper, 1999], the architectural significance of media architecture requires designers to work towards length of life rather than end of life. Such attitudes are not too dissimilar from how architects and building owners consider scenarios for adaptability in response to changing circumstances.

- **How to maximise length of life?** Our research showed that participatory design supports people's acceptance of media architecture. Previous research has shown its value for stimulating sustainable behaviour [Wever et al., 2008]. While people's acceptance is inarguable one relevant factor of sustainability, future designs should consider using established methodologies to optimise other factors, such as Life Cycle Assessment to assess environmental impact [Curran, 2012] or Value-Centred Design to maximise relevance [Cockton, 2004].

- **How to deal with change?** After the deployment of media architecture, all stakeholders should be given opportunities to voice their opinions through accessible feedback channels, such as appointing and announcing local representatives, providing feedback forms or by enabling shared moderation (see Section 8.2.3: Significance of Community Involvement). Such opportunities must allow for a timely and proactive response to opposition and disapproval, and should instead sustain the acceptance and relevance of media architecture.

8.2.6 Significance of In-the-Wild Research

Our studies have been conducted in the wild, i.e. in real-life environments. We gained insights with high ecological validity, capturing many of the complexities that characterise the situations in which our prototypes were deployed [Rogers et al., 2007]. However, we were also confronted with various challenges that might be inherent to conducting research in public space. In two cases, these challenges resulted in the premature ending of studies (see Appendix).

- **Political involvement**, such as the refusal to publish messages onto existing public displays due to a perceived risk of political recuperation;

- **Legal processes**, such as the lengthy approval processes for conducting research in public space, or the multiple approvals required from local and federal authorities, prior to conducting research with refugees;

- **Logistical needs**, such as the time-consuming processes to recruit a sufficient number of participants; and

- **Technical roadblocks**, such as instances of unreliable internet connection in people's private residences.

The breadth of these challenges creates unique opportunities for researchers to gain proficiency in various disciplines. In our research, we positioned ourselves as researcher (e.g. laying out research objectives and methodology, and analysing results) while also taking up roles as designer (e.g. transforming participant input into usable and consistent designs), craftsman (e.g. constructing encasings for public displays, through digital fabrication and carpentry), engineer (e.g. developing custom electronic circuits for alternative public displays), software developer (e.g. coding custom websites to allow households to control content on public displays), project manager (e.g. keeping track of the overall study progress) and support engineer (e.g. technical follow-up of study prototypes). Touching upon these disciplines allowed us to gain insight into the complex and interdisciplinary process that is inherent to designing and developing media architecture.

One may suggest that we would have been likely to achieve the same, better or a higher quantity and quality of results if we had conducted our research in a controlled environment, such as a lab that does not suffer from the challenges introduced in public space. However, we disagree. In-the-wild studies are currently well established and widely appreciated, as they yield ecologically valid insights into how technologies are appropriated in the real world [Rogers et al., 2007]. We specifically recognise these benefits in many of our research outcomes.

Design Considerations. In-the-wild research supports the ecological validity of research outcomes. Even though some of the challenges may seem overwhelming, we believe researchers can prepare themselves.

- **How to prepare for challenges?** Our view is that early awareness of potential roadblocks may positively influence future in-the-wild research efforts, by enabling researchers to plan more effectively. For example, each of our case studies was fundamentally different in its research goals, and its technical, functional and contextual characteristics. Allowing these characteristics to somehow be transferable across case studies may benefit future endeavours, without unnecessarily limiting the potential research outcomes.

8.2.7 Significance of Engagement

Media architecture is appreciated for its unique potential to engage citizens by creating digitally augmented experiences in public space [Dalsgaard and Fritsch, 2008; Sparacino et al., 2000]. Our studies showed how the engaging qualities of media architecture range from promoting interaction and participation within neighbourhoods (such as by contributing and consuming locally relevant content) to raising awareness about major societal issues. During our research we were confronted with high and sustained levels of participation, as well as (unexpectedly) low levels. In retrospect we identified several methodological, social and cultural factors as contributing to those restraints, ranging from environmental conditions, such as climate and time of day, to societal influences, such as a potentially controversial and political message. Despite some instances of low participation, we recognise a relatively consistent high level of engagement. For instance, residents interacted with *StreetTalk* as a means to remain informed about local events, and passers-by interacted with *Stories of Exile* to gain a deeper understanding of refugee displacement. Understanding and aiming for engagement is vital in contextualising media architecture, rather than solely aiming for high participation rates. In fact, low participation rates may conceal high levels of engagement, such as when opportunistic interactions result in recurring practices to emerge.

The multidisciplinary nature of our research has provided us with insight into the aspects that affect engagement. Our insights are integrated within the honeypot model that serves as a framework for annotating the impact of audience engagement and seeking opportunities for optimisation (see Section 6.5: Honeypot Trajectories and Influences). The model highlights the role of spatial factors in influencing engagement, such as providing comfortable zones for people to acquaint themselves with the expected interaction, and convenient and accessible trajectories to abandon from interaction. The dynamic nature of the honeypot model creates opportunities to optimise engagement with media architecture, even after realisation. For instance, audience observations may reveal a disruption in audience flow, a need to further clarify goals to audience members, or a negative spark that deters from engagement rather than motivates engagement. The spatial setup of *Stories of Exile* resulted in a funnel-shaped zone for bystanders and audience members to familiarise themselves with the media facade. We believe a majority of people felt confined and uncomfortable, prohibiting them to progress towards participation.

Design Considerations. Media architecture elicits new perspectives onto public space. As such, we argue media architecture should enable opportunities for people to engage with each other, and do so in sustainable ways.

- **How to design for engagement?** The spatial nature of the honeypot model reveals an applicability within an architectural discourse. It provides a method to support the contextual relevance and sustainability of media architecture. By regularly assessing the 'success' of engagement, necessary spatial adaptations to support social interaction will emerge. In particular, space should enable opportunities to 1) exchange information between former and new participants; 2) learn about social norms; and 3) recommit in engagement without any repercussion.

8.2.8 Significance of Craftsmanship

The physical realisation of our case studies involved attention to craftsmanship, including new digital techniques, such as 3D printing and laser cutting, but also embracing more traditional methods, such as carpentry and developing electronic circuits. These tools, toolkits and frameworks are becoming increasingly accessible to lay people. In our own research we have resorted to many of these tools. We observed that the resulting handmade aesthetic of our prototypes facilitated residents and passers-by to interact with the prototypes and with the households that maintained them. Remarkably, despite the visual and physical fragility of our prototypes, none of them were confronted with vandalism.

The possibilities that today's fabrication technologies introduce, are leading to – what some call – a new industrial revolution. People are empowered to shape and personalise the material goods they consume [Mota, 2011]. The new possibilities also enable designers and researchers to develop prototypes that allow for more *natural* forms of interaction and for lower barriers to participation, due to an absolute freedom to maximise functionality and minimise learning for the intended audience [Taylor et al., 2012; Koeman et al., 2015; Fredericks et al., 2015]. With this dissertation we have contributed to a growing interest in using fabrication techniques for research prototypes [Willis et al., 2012; Klein, 2015]. Our research in particular has further explored the synergies between fabrication and participatory design as a source of information.

Design Considerations. Our study illustrated the reasoning behind negative attitudes towards some media architecture. However, the degree of craftsmanship and the hand-made look and feel of our prototypes have allowed us to support the 'crafting of place' [Caldwell and Foth, 2014] and to reflect the power of personal creativity and making [Tanenbaum et al., 2013].

- **Why is craftsmanship significant?** Active involvement of citizens allows for new forms of do-it-yourself urbanism to emerge [Ratto et al., 2014; Paulos et al., 2009]. In direct opposition to traditional top-down urban change, residents are empowered to reclaim the right to the city by creating and deploying self-generated, low budget and often temporary interventions [Talen, 2015]. We argue that enabling residents to act as craftsmen and promoting do-it-yourself urbanism supports the value of media architecture in contributing to the experience of urban space, to the emergence of 'place' and to the appreciation by local community members. It enables the fabrication of media architecture that not only embodies creative insights of residents themselves, but that is also conscious of the surrounding social and architectural context.

8.3 Guidelines Summary

In the following section, we provide a concise overview of design considerations for contextualising media architecture. The considerations build upon the insights laid out in previous sections, but are reformulated specifically to support designers, architects and urban planners in the design process of media architecture.

8.3.1 Designing for Situatedness

- Engage local stakeholders in the physical design of media architecture, such as by employing participatory design (see Section 8.2.4: Significance of Participatory Design) and by promoting the use of digital fabrication tools (see Section 8.2.8: Significance of Craftsmanship).

- Engage local stakeholders in building and maintaining a library of content, such as by providing them with accessible means to share suggestions or voice opinions and concerns (see Section 8.2.5: Significance of Sustainability).

- Empower local stakeholders to collaboratively moderate and curate content (see Section 8.2.3: Significance of Community Involvement).

8.3.2 Designing for Architectural Integration

- Expand the design space of media architecture, beyond flat and rectangular screens towards integrated artefacts that reflect the architectural design rationale (see Section 8.2.2: Significance of Architecture). Also consider whether other and uncommon elements of the built environment are able to transform into media architecture and to create compelling atmospheres (see Section 8.4: Future Work).

- Appeal for media architects to share insights about aspects such as technology and interactivity, in order to achieve a symbiosis between architecture and digital media (see Section 8.2.2: Significance of Architecture).

- Design media architecture as a scenography, allowing architecture and urban residents to mutually support media architecture in creating compelling and poetic experiences of the urban environment (see Section 8.2.1: Significance of Context).

- Evaluate the message of media architecture through the lens of architecture, such as by investigating the architectural integration of content, the effect of building occupancy on the perception of content, and the effect of media architecture on its surroundings (e.g. brightness).

8.3.3 Designing for Engagement

- Optimise the physical design of interaction zones for the intended audience to comfortably interact (see Section 8.2.7: Significance of Engagement). Seek a balance between the physical dimensions of the sensor area and the effect of social constraints (e.g. a small area requires people to stand close), and between the proximity of physical boundaries and ergonomic constraints (e.g. a small area limits the freedom to move).

- Provide spaces for people in varying user roles to congregate and interact, as a way to learn about media architecture and the supported forms of interaction, as well as an incentive for new and inexperienced users to progress towards interaction (see Section 8.2.7: Significance of Engagement). Make sure these spaces provide social comfort and allow visibility upon media architecture, in order for users to gain familiarity with the norms of interaction.

- Study opportunities for media architecture to have or gain relevance within its surroundings (see Section 8.2.1, for instance by conveying messages that are rooted in the local context. Local relevance has proven to stimulate engagement.

8.3.4 Designing for Sustainability

- Design media architecture for length of life, where adaptability is a core characteristic and intrinsic quality (see Section 8.2.5: Significance of Sustainability). Community involvement and lifecycle assessments are vital steps in warranting sustainability.

- Document the flexibility of media architecture to deal with architectural repurposing, such as by incorporating the ability to change content when building occupancy changes or when buildings are temporarily unoccupied.

- Design media architecture that is able to deal with societal changes, such as by providing accessible means to change content when it is no longer considered up-to-date or relevant within the surroundings.

- Make media architecture future proof, such as by documenting the capabilities for forward compatibility with potential technological advances (e.g. novel interaction modalities).

8.4 Future Work

The exploratory and cross-sectional nature of our research has, unfortunately, not permitted to conduct any longitudinal studies. For instance, *OpenWindow* and *StreetTalk* have been evaluated for three and eight weeks, respectively. While we have gathered ample insights within these short timeframes, some questions may have remained unanswered. For example, we have noticed several challenges with regards to sustaining engagement with media architecture. Hence, we propose that further research is required to reveal how particular technical possibilities, functional characteristics or design decisions affect the long-term and sustained interest in citizen-driven media architecture. The Honeypot Model that was developed based on the analysis of *Encounters* yields various suggestions on how to stimulate engagement, but other contexts may reveal the existence of other components.

We believe that additional research is required to further unravel the opportunities and challenges of more community-driven and community-situated forms of media architecture, open content control, and moderation and curation responsibilities shared within neighbourhoods. We can, for example, imagine public display networks that are situated in residential communities and that offer a collective, open and community-moderated platform for sharing information with a hyperlocal relevance. Such endeavours will however need to seek answer to a range of new questions. For instance, how do moderation processes affect the openness of such systems; how do communities deal with inappropriate content (and what is considered inappropriate content); what are the implications of open content control on distinct forms of media architecture, such as public displays and media facades; and how can community control stimulate sustained interest and relevance?

While participatory design has been invaluable for our research outcomes, we are aware that real-life and profit-driven deployments may find this approach challenging, rather than revealing. The considerable commitment towards time and resources makes participatory design a slow process as insights require cultivation [Bødker and Iversen, 2002; Spinuzzi, 2005]. At this point, we have not come across any profit-driven deployments of media architecture that adopt a participatory design methodology. However, we believe that such deployments may still embrace participatory design to innovate within their existing product range, and to assist in (re-)orienting design and functionality to better align with the changing needs of urban residents [Sanders and Stappers, 2008].

We revealed additional insights into the significance of the honeypot effect, as a series of trajectories and influences. We believe our spatial recommendations are not only applicable to interactive installations such as *Encounters*, but are also relevant in the broader context of media architecture. For instance, in *Stories of Exile* we observed that the narrow laneway posed challenges for some people to enter and approach. Research in this domain should reveal insights into the role of the spatial arrangement in affecting the success of the honeypot effect and the interplay between the scale of media facades, and the subsequent positioning and performance of the activation loop. Also, we believe that media architecture in residential areas poses new challenges and opportunities to maximise the honeypot effect. For instance, in *StreetTalk* we learned that the situatedness promoted encouragement among local residents but deterred more distant residents from interacting. Additional research should reveal the role of triggers in permanent and situated manifestations of media architecture, and which aspects may act as negative sparks rather than positive sparks. We believe such questions should be answered through close involvement with architects and experts in spatial planning.

Ultimately, we believe that our analysis motivates further reflection on how ordinary, unconventional elements of the built environment can fulfil a role as media architecture. We believe that one may well consider embracing the qualities of existing street furniture as situated carriers for sharing hyperlocal information in urban neighbourhoods. Here, a range of new questions emerge: what entails the notion of mediatised street furniture; how do they affect social relationships in public space; what is the role of the public character of street furniture; who is in charge of control; how can architectural design qualities be integrated; and ultimately, to what extent should such endeavours still be considered as manifestations of media architecture?

8.5 Closing Remarks

As various forms of media architecture become ubiquitous building blocks of our contemporary urban environment, the challenge arises to render them contextually relevant, in particular by taking the social fabric and architectural environment into consideration. We cannot expect their primary purpose to remain commercial, artistic or entertaining in nature. Instead, in the cityscape of today, where cohesion and communication seem to be challenged by a growing sense of individualism, we believe ample opportunities exist to employ media architecture in public space for socially relevant purposes. These opportunities raise the need for cross-disciplinary collaboration, encompassing the fields of architectural design, human-computer interaction, user-centred design and social sciences.

This dissertation unfolds the opportunities for media architecture to grow into a contextually relevant phenomenon, based on the results and analysis of six case studies. Their individual contribution resides in revealing the aspects that are inherent to the further contextualisation of media architecture, such as through the involvement of citizens, the expansion of the prototypical design space, and the local relevance of the message. Their collective contribution resides in providing insights and design recommendations to a wide range of stakeholders, including architects, citizens, authorities, interaction designers and researchers.

Appendix

Appendix A: Muqarna

Muqarnas of Kruger Square was conceived as a participatory project, in collaboration with residents from Borgerhout, Antwerp, and a local community organisation. A series of design workshops aimed to investigate potential application scenarios for situated media architecture (see Figure 8.1). Residents collectively analysed and mapped the neighbourhood. Kruger Square was identified as a relevant location to host some form of media architecture, largely as a result of the square's neglected status and an increasing sense of insecurity at night. During daytime, youth regularly uses the square for leisurely activities.

Out of the imagined concepts grew *Muqarna*; a series of 16 independent lighting modules, attached in between the oak trees that define the appearance of the square. In promoting collective use of the square, the LED pixels of each lighting module are individually controllable by residents via a public webpage optimised for mobile devices (see Figure 8.2). Through individual control, residents are able to influence the collective spatial atmosphere of the square, either in real-time or after scheduling their animation to be (re-)displayed at a later point in time. The study aimed to investigate the emerging usage patterns, the effect on the atmosphere of Kruger Square, and the effect on social interactions.

Muqarna was developed in *Arduino*, with a control application in *Processing* (*Java*), and further supported with *WebSockets* for real-time communication between personal mobile devices and the control application. A dedicated domain name and public server infrastructure was configured for the study, in order to host the public web application. The technical infrastructure was developed over a two month timeframe in late 2014. *Muqarnas* were subsequently tested for three months in indoor conditions (see Figure 8.3), inclusive of the end-user interaction via the public webpage (see Figure 8.4). However, the installation of *Muqarnas* in outdoor conditions soon revealed that condensation caused short circuits in the sensitive electronic components. The additional cost to resolve the engineering issue and the reducing support from a local community organisation, resulted in the decision to prematurely terminate the study.

Figure 8.1: A participatory mapping session engaged local residents in exploring the neighbourhood and collectively brainstorming potential scenarios of situated media architecture.

Figure 8.2: Artist impression of individual *Muqarna* lighting modules in between trees on Kruger Square.

Figure 8.3: Set of four *Muqarna* lighting modules in temporary test set-up on the first floor of a popular local bar.

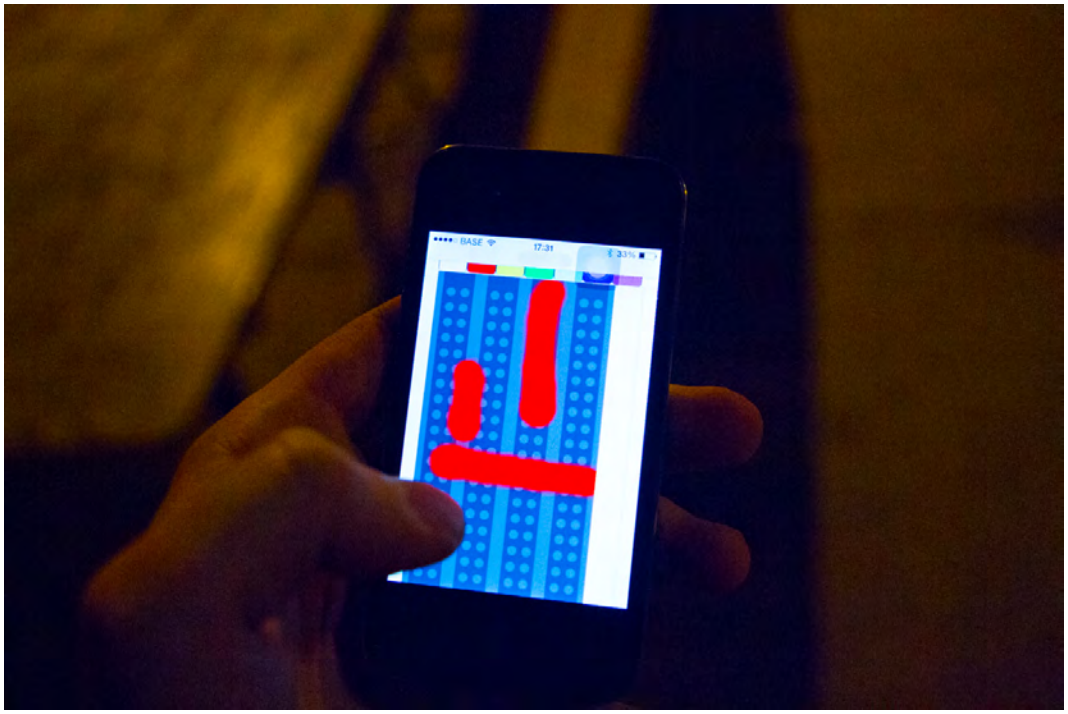


Figure 8.4: Interaction with *Muqarnas* was optimised for mobile devices, so as to support touch gestures and control the corresponding LED modules in real-time.

Appendix B: Caring Community

In exploring opportunities to fulfil a more established local role, a nursing home in Zoersel, Belgium seeks to actively involve the neighborhood in the activities they organise for elderly residents. They envisioned a technical platform to stimulate communication between people that are in need of care and those that are able to provide care. Within this context, we were approached to apply our expertise in integrating public displays, and to explore opportunities to facilitate communication between two distinct user groups. Possible content was imagined to consist of:

- announcements for activities, seeking active participation, volunteering, awareness or dissemination;
- general messaging controlled by residents of the nursing home; and
- opportunities for community members to communicate with residents of the nursing home, by using the public display and its messaging capabilities as a physical and accessible port of entry.

We deployed one touch-enabled public display in locally relevant locations; i.e. the lobby of the nursing home and the storefront of a local pharmacist (see Figure 8.5). Residents of the nursing home were already supported in adopting novel technologies, such as tablet computers that would serve as interfaces to control the content on the public display.

We anticipated a range of technical challenges (e.g. user experience, technological adoption) as well as a general unwillingness to commit to volunteering opportunities via a digital display. As such, a pilot study was set up to explore the technical and social feasibility of our concept in real-life circumstances. A *HTML* interface was developed and optimised for touch interaction (see Figure 8.6), and the public display was subsequently installed for 8 consecutive days in the local pharmacy and the nursing home.

Despite a large number of viewers in both locations, we did not capture a single interaction. Interviews revealed that the threshold to volunteer is high, even more so when the advertiser is not known or invisible. The study was abandoned after reviewing the preliminary results.

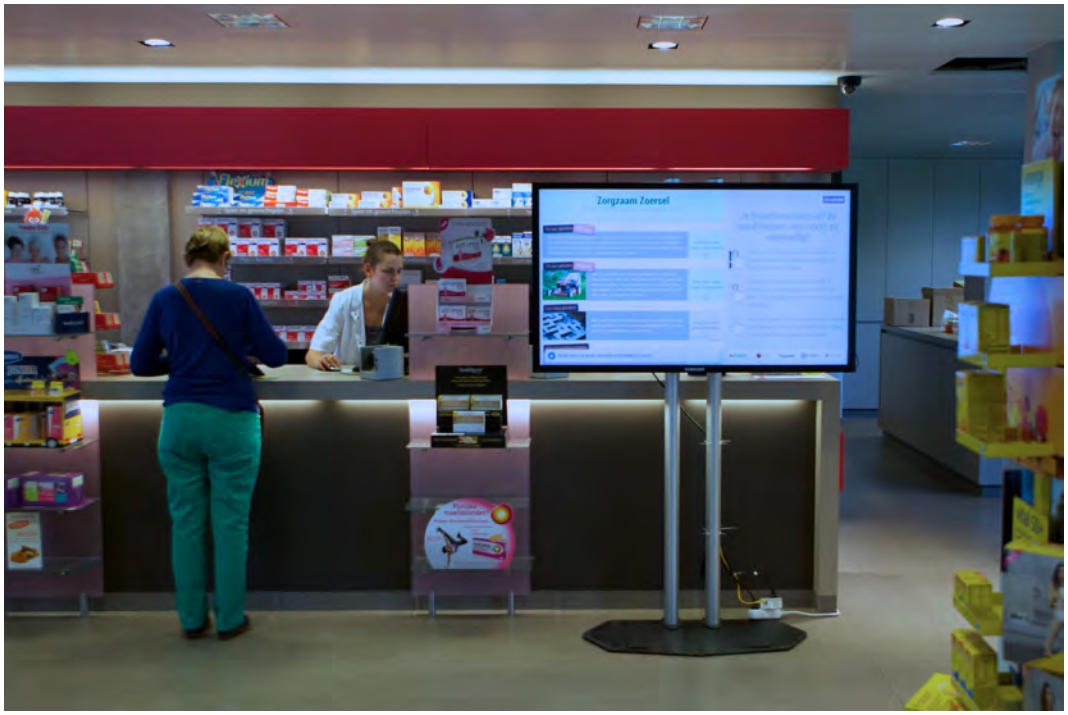


Figure 8.5: Set-up of the *Caring Community* display in the shopfront of a local pharmacy. The interface contained various animated components, and showed a list of various volunteering requests. Upon touching, an opportunity to leave a phone number or email address appeared.

Figure 8.6: Close-up of public display interface, containing a live updated feed of active volunteering requests (left) and interaction guidelines (right).

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